ON THE

EXPECTED RETURN

OF

THE GREAT COMET

OF

1264 AND 1556;

WITH

A HISTORY OF FORMER APPEARANCES,

COMPILED FROM VARIOUS AUTHORS

AND

EPHEMERIDES

FOR FACILITATING ITS RE-DISCOVERY.

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PREFACE.

The interest attaching to the probable re-appearance of a great Comet revolving round the sun in the long period of nearly three hundred years has induced me to draw up, in as popular a style as possible, a general account of its former appearances, and an explanation of the grounds on which astronomers have considered themselves justified in anticipating the return of the Comet about the present year, as an event of at least fair probability. This little work contains, I believe, nearly all that is known on the subject, from the writings of ancient historians, chroniclers, and cometographers. The reader will therefore have before him the whole data on which the identity of the Comets of 1264 and 1556 has been inferred; and I trust the particulars are given with sufficient clearness to enable him to judge for himself, without much trouble, what degree

of confidence is to be placed on its expected return about the present time. The ephemerides will, no doubt, suffice for all practical purposes, and may possibly lead to the re-discovery of the Comet soon after it is visible in our telescopes. The positions for any date, on different hypotheses, for the time of arrival at perihelion, may be laid down on a chart, and the "sweeping-line" in which the Comet will probably be found can thus be ascertained.

The time of re-appearance is, I conceive, very uncertain; and the importance of recognising the Comet, should it again visit us, requires that strict watch be kept on the neighbourhood where it is most likely to shew itself, and that this examination of the heavens be continued until there is no longer any probability of its return.

My calculations relating to the Comet have been pretty extensive, and I have not omitted to examine closely all the circumstances recorded respecting it. The conclusion at which I have arrived is this,—that there is a *very high probability* in favour of the supposed identity of the Comets of 1264 and

1556. This opinion is not hastily offered, as will be seen from the details of my investigation, given in the following pages. At the same time, I am aware that it would be *possible* to represent the facts mentioned by historians in 1264, with elements differing materially from those of the Comet of 1556. The reader will not fail to bear in mind, in forming his decision, that in the year 975, a Comet is recorded, which has great analogy to the one in question.

J. R. HIND.

London, May, 1848.

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THE GREAT COMET,

&c., &c.

CHAPTER I.

General Description of the Comet of 1264.

Nearly all historians who have written on events of the thirteenth century mention the great and splendid comet of 1264, and many among them were eye-witnesses of the facts they relate. The first appearance of this comet is dated, as might be expected, at various times by different authors.

Friar Giles, of whom I shall have occasion to speak more fully hereafter, says it was discovered in France on the 14th of July. It was certainly observed in that country on the 17th of the same month, as we learn from a poem by Thierri on the life of Pope Urban IV.: it was then observed in the evening, after sunset. The chronicle of John Vitoduranus the *Chronicon S. Ægidii Brunswicensis,* and the *Chronicon S. Petri, vulgò Sampetrinum Erphurtense* in Menkenius' collection of Saxon writers, say the comet was perceived on the morning of July 22nd. Another authority dates the appearance on July 25th, before sunrise. On the 26th of July the comet was detected in China, according to the annals of the dynasties *Ming* and *Youen,* then reigning in the north and south of that country.

The poem of Thierri, already mentioned, is published in the historical work entitled "*Rerum Italicarum Scriptores,*

&c., collecti à Ludovico Muratorio," Milan, 1723, and elsewhere. Thierri thus describes the appearance of the comet—

" Post hæc dicenda sunt stellæ signa comatæ
Quæ mortem tanti nos docuere viri,
Ejus enim morbum monstravit visio, mortem
Defectus, sicut tempora certa probant.
Bis sexcentenum Domini, decies quoque senum
Annum, cum quarto, si bene mente notes ;
Manè quidem, luce Domini, sextoque calendas
Augusti, nobis visio facta fuit.
Undecimumque gradum Phœbo superante Leonis,
Ter deno Cancri restitit illa loco.
Retrogradus motus in partes occiduas, in
Meridiem motus additus alter erat,
Sic utrimque movens transivit Oriona, visa
Septuaginta dies hâc regione fuit.
Sed sexto-decimo, ferò, priùs ante calendas
Augusti mensis, Gallia vidit eam.
Tuscia non solùm stellam, vel Francia vidit
Istam, sed populus vidit in Acon eam.

* * * * *

Quo *(Urbano)* moriente, velut mortem cognosceret ejus
Apparens minimè stella comata fuit."*

Pope Urban IV. died on October 2nd. Many other historians relate that the comet was last seen on the night of the Pope's death.

A contemporary Italian writer, Ptolemy of Lucca, whose annals are found in the great collection of Ludovico Muratori, agrees with Thierri. "A comet of surprising magnitude," says he, "was seen in Italy; it appeared first in Cancer, thence advanced gradually towards the south until it approached the constellation Orion : it was visible many months." The chronicle of the Monk of Padua tells us that "it commenced

* See Appendix, page 76.

appearing between the east and north : it shot out its threatening rays towards the west, was first seen in July, and disappeared at the commencement of October." The Annals of the Dominicans of Colmar state that "the comet appeared in the east before sunrise, about the calends of August, and was seen forty days. It was, at first, large and bright, having a long and broad tail, which diminished daily." The Belgian Chronicle assures us that, in the year 1264, a comet appeared of such remarkable magnitude, that no one who saw it had witnessed its equal before. For, rising from the east with great splendour, it extended its brilliant tail past the "mid-heaven," westward. It was seen from the month of July until the end of September. The head was obscure, but the tail stretched out far and wide, "resembling, in magnitude and form, the sail of a ship." The comet rose later each night, at least, such is the natural interpretation of the words "singulis verò noctibus paulò serius exurgebat." The tail, diminishing in breadth, increased in length. On the 10th of the calends of October (September 22nd) it was in the south, before daybreak, and the train, "nearly a cubit broad," reached almost to the west. John Vitoduranus and an anonymous German chronologist say—a star, which is called a comet, appeared in the east before daybreak, after the morning star, with many rays, which were seen far and wide, before the comet itself had risen. The head moved so quickly towards the south that it soon preceded the planet Venus, which was then a morning star. It was seen from the feast of St. Mary Magdalen until that of St. Augustin, according to Vitoduranus, or until the eighth day of the feast, according to the anonymous author.

In another account of the life of Pope Urban IV., written by Bernard, a comet is stated to have appeared about the middle of July, at the commencement of the night, in the western heavens ; after a few days it was observed in the east

towards daybreak: it continued visible until the end of September. An Italian writer dates the discovery of the comet on the 8th of the calends of July, or June 24th, and limits the period of its visibility to two months. Probably this author has dated the first appearance one month too early, as it is certain that the comet was seen in Italy during September.

In the library of Pembroke College, Cambridge, a manuscript has been discovered entitled "*Tractatus Fratris Ægidii de Cometis.*" Several extracts from this manuscript, relating to the comet of 1264, are published in the Philosophical Transactions, vol. xlvii., p. 282: they are contained in a letter from Mr. Richard Dunthorne to the Rev. Dr. Long, Lowndes Professor of Astronomy in the University of Cambridge. The writer says,

"Stella caudata seu crinata apparuit in regno Franciæ in oriente ante solis ortem a 19° kalendas Augusti usque 5° nonas Octobris in anno Domini 1264—Cometem, cujus occasione hæc scripsimus, primò vidimus extra circulum Zodiaci versus Aquilonem contra Cancrum, et demum eundem vidimus extra circulum versus austrum sub Geminis inter Canem et Orionem. Vidimus autem et stellam caudatam, cujus occasione hæc scripsimus, præter motum circularem diurnum æque moveri motu retrogradationis, et nulli alii similis, secundum latitudinem ejus, quæ est a septentrione ad austrum. Visus est moveri per duos menses solares plusquam 40gr adus, vix per 3 gradus longitudinis permutans situm.—Cometes, cujus occasione hæc scripsimus, primò visa est in vespere post solis occasum demum post paucos dies, solem pertransiens, in mane circà octavum gradum Cancri, et ex hinc citò processit retrò in Geminos:—vidimus autem et cometem moveri ab Aquilone ad Austrum, secundum latitudinem quidem plus 50 graduum et secundum longitudinem quidem vix 5 gradus processisse."*

Mr. Dunthorne, and Mr. Struick, the Dutch cometographer, suppose that by "19 Kalendas Augusti," the 14th

* See Appendix, page 76.

of July is meant. Admitting this to be the fact, Friar Giles makes the comet's appearance to extend from July 14th until October 3rd. It is hardly possible to read the above account without noticing one manifest contradiction regarding the amount of the comet's motion in longitude. We are told that the change of longitude during the twelve weeks was hardly 5°, while the writer states just before, that the comet quickly retrograded from the eighth degree of Cancer into Gemini, and, passing the sun, was seen in the morning; indicating a motion of nearer 50° than 5°.

Matthew Paris, speaking of the comet of 1264, assures us it was so remarkable an object, that none who beheld it had seen its equal before. It rose in the east with great splendour, stretching out its tail past the mid-heaven towards the west. After continuing visible three months, it disappeared on the night of the death of Pope Urban IV. (October 2nd).

The epithets "notabilis," "insignis magnitudinis," "magnus et clarus," &c., are not spared by historians in their descriptions of this comet. It is pretty certain that, in apparent size and brilliancy, it must have far surpassed any previously observed by those who were eye-witnesses of its movements.

Nicephoras Gregoras, in his *Historia Byzantina*, has the following, with respect to a comet which nearly all historians and writers upon the subject before Pingré's time refer to the year 1264. "It appeared near the sign Taurus. It was seen at night, shortly before daybreak, a little above the horizon. As the sun advanced according to the order of signs, so the comet gradually rose above the horizon, until it passed the mid-heaven. For, when it first appeared, the sun, traversing Cancer, brought again the summer upon the earth: autumn equalized the days and nights when the comet lost its light and was dissipated. So, from the summer solstice to the autumnal equinox, the sun passed

through the space of three signs, the comet always remaining as it were fixed near Taurus." Gregoras does not assign any particular year for the appearance of this comet, but merely says it became visible when Charles of Anjou was king of Italy, and in a condition to aid his ally Baldwin, deposed from the throne of Constantinople. This remark, taken in conjunction with the succeeding observations in the *Historia Byzantina,* shews pretty clearly that the comet to which Gregoras refers did not appear until 1266; and, consequently, that historians and cometographers, before Pingré wrote, had confounded it with the comet of 1264.

An anonymous writer, commenting upon the work, *Georgii Pachymeris, Michael Palæologus,* when in manuscript, accused the author of more than one error, in observing of the comet of 1264, that "it appeared from spring until autumn from the east to the west." He had written upon the margin of the manuscript, "The historian has not related the fact as it really was: the comet in question, as we observed it with our own eyes, moved from the east, *(ab oriente movebatur,* ἐξ ἀνατολῆς την κίνησιν ἐποιεῖτο*)*; it appeared near the Hyades. I do not accuse Pachymer of error in saying it appeared about the northern part of the heavens,—for Taurus, in which are the Hyades, is a northern sign; but this author is contradicted by all other writers, not only in reference to the course of the comet—which was, according to them, from the east to the mid-heaven—but also as regards the time of its appearance: they testify that it was seen during the months of July, August, and September, and not from spring until autumn." There can be no doubt that the anonymous annotator has confounded the comets of 1264 and 1266. The time of appearance from spring until autumn, assigned in the *Historia Byzantina,* disagrees with the accounts in other histories and chronicles. Pingré remarks that the author does not say the comet was

seen from the commencement of spring until the end of autumn; but, even if we understand his meaning to be that it was observed from the end of the spring until the beginning or middle of the autumn, the first appearance is dated at least one month too early: by far the greater number of the historians tell us that the comet became visible between the 22nd and 26th of July.

As might be expected, authors, ancient as well as modern, differ as to the duration of the comet's appearance. Martin, the Franciscan Friar, saw it from the Feast of St. James (July 25th) until that of St. Michael (September 29th). The Annals of Breslau and the Chronicles of Silesia date its appearance from July 28th until October 2nd. According to the Annals of the Dominicans of Colmar, it was not observed till August 1st, and its duration extended to forty days; which agrees with the account of James, Archbishop of Geneva. A Chronicle in Muratori's collection—*Memoriale Potestatum Rhegiensium*—mentions August 7th as the day of its discovery. The *Chronicon Claustro Neoburgense,* which Pingré considered very exact in its dates, says the comet appeared during eighty days. The Chronicle of Augsburg, compiled about the end of the fifteenth century, fixes its final disappearance in the fourteenth week after the first discovery. Lavather, Palmerius, Rockembach, and many other cometographers, agree in stating that it was seen in the east about the month of August, that its tail stretched upwards towards the mid-heaven, and that it continued visible about three months.

The Comet of 1264 was observed by the astronomers of the dynasties then reigning in the north and south of China.

In the fifth year of the period *King-ting,* on day *Kia-su* of the seventh moon (July 26), a comet was seen in the sidereal division *Lieou* (commencing at δ Hydræ). Its tail was curved, and illuminated the heavens for an extent of

more than 100 degrees: when the sun had risen, it disappeared. During the rest of the moon, its course was as follows: day *Ki-mao* (July 31st), it retrograded, and was seen in the division *Yu-Kouei* (commencing at θ Cancri): day *Sin-sse* (August 2nd), it was in the division *Tsing* (determined by μ Geminorum): day *Ping-chin* (August 17th), it was seen in *Tsan* (commencing at δ Orionis): and on the day *Wou-su* (August 19th), it was in the middle of the degrees of the division *Tsan*. At the end of the eighth moon, or about September 22nd, the luminous tail began to disappear. The comet was seen, in all, during four moons.

Such is the description furnished by the annals of the dynasty *Soung*, then reigning in the south of China. The history of the dynasty *Youen*, who governed in the north of that country, has the following account.

In the first year of the period *Tchi-youen*, on day *Kia-su* of the seventh moon (or July 26th), a comet was seen in the division *Yu-Kouei* (commencing at θ Cancri). In the evening it appeared in the north-west; it traversed *Chang-tai* (ι, κ, Ursæ Majoris); swept over the group *Wen-tchang* of *Tse-wei* (θ, υ, ϕ Ursæ Majoris), and also *Pe-teou* (α, β, γ, δ, ϵ, ζ, η of the same constellation). In the morning, it was seen in the north-east. In all, it appeared about forty days.

In order to understand these accounts, we must bear in mind that the Chinese sidereal divisions are irregular equatorial intervals, measured from the determining star of the division, which is here given in brackets. When a comet is stated to be in one of these divisions, we know that its right ascension would lie between that of the determining star and the limit of the particular division which is known; but we have no information respecting the comet's declination, which may be any value between $+ 90°$, and $- 90°$. However, it very seldom happens that we are unable to form

some idea of the distance from the equator, either from the position of the division in the heavens at the time of observation, or from collateral accounts. The Chinese themselves very frequently mention some of the constellations through which the comet passed or swept with its tail; and their constellations were of the same kind as our own, and must be carefully distinguished from the sidereal divisions.

In 1264, *Lieou*, commencing at δ Hydræ, began in R. A. 119°,5, and extended 15° towards the east, or to R. A. 134°,5. *Yu-Kouei* began in R. A. 117°,3, and extended 4° only towards the east, or to 121°,3: this division was therefore partly included in *Lieou*. *Tsing*, the most extensive of the Chinese divisions, commenced in R. A. 84°,6, and ended in R. A. 117°,6, where *Yu-Kouei* began; while *Tsan* comprised the interval between R. A. 73°,6 and 82°,6; so that the middle of the degrees of *Tsan* would, in 1264, be R. A. 78°.

On July 26th, the comet was seen in *Yu-Kouei*, according to the astronomers of the *Ming* dynasty, and the observers in the south of China say it was situated under the division *Lieou*, which in fact amounts to the same thing, if we suppose the right ascension between 119°,5 and 121°,3; that interval being common to the two divisions. On July 31st, the comet was observed under *Yu-Kouei*, in the south of China, so that the R. A. would not be less than 117°. Two days afterwards, it appeared in *Tsing*, from which nothing very definite can be deduced, owing to the great extent of this division. On August 17th, it was seen in *Tsan*, and in the middle of that interval on the 19th, so that its R. A. would be 78°. We may, therefore, assume that the comet would be situated near the latter end of the division *Tsing* on August 2nd.

The following is a list of the Chronicles, Histories, &c., which contain particulars relating to the Comet of 1264, and from which the present account has been drawn up :—

Excerpta è vetustissimo Calendario manuscripto Ambrosianæ Bibliothecæ, found in the collection of Italian authors by Muratori, entitled "*Rerum Italicarum Scriptores, &c., collecti à Ludovico Muratorio.* Mediolani, 1723, &c., *folio.*

Tractatus Fratris Ægidii de Cometis, a manuscript preserved in Pembroke College, Cambridge, and cited in the Philosophical Transactions of the Royal Society of London, vol. XLVII. p. 281.

Anonymi Compilatio Chronologica, ab initio mundi ad annum 1474, found in the collection of German writers, entitled *Rerum Germanicarum Scriptores aliquot insignes, olim collecti per Joannem Pistorium. Editio tertia, curante Burcardo Gotthelssio Struvio.* Ratisbonæ, 1726, *folio.*

Chronicon S. Ægidii Brunswicensis (*ad annum* 1474), in the work *Scriptores Rerum Brunswicensium*, published at Hanover in 1707, *in folio.*

Chronicon S. Petri, vulgò Sampetrinum Erphurtense, (*ad annum* 1355) in Menkenius' collection of Saxon writers.

Scriptores Rerum Germanicarum, præcipuè Saxonicarum. Edidit J. Burchardus Menkennis. Lipsiæ, 1728, *in folio.*

Monachi Paduani Chronicon, in the collection of Italian authors already cited, and in *Thesaurus Antiquitatum et Historiarum Italiæ, curâ et studio Joannis - Georgii Grævii.* Lugduni-Batavorum, 1704, *in folio.*

Georgii Pachymeris, Michael Palæologus. Roma, 1666, *in folio.*

Martini Minoritæ, Flores Temporum, ab Hermanno Januensi continuati usque ad Carolum IV., in the historical work entitled *Corpus Historicum Medii Ævi, editum à Joanne Georgio Eccardo.* Lipsiæ, 1723, *in folio.*

Vita Urbani IV., carmine eligiaco descripta, per Thierricum Vallicolorem, excerpta è Vitis Summorum Pontificum apud Papyrium Massonum, lib. V. de Episcopis urbis Romæ, in Muratori's collection.

Vita Urbani IV., è manuscriptis Bernardi Guidonis, in the same.

Ptolomæi Lucensis Annales, in the same.

Annales Dominicanorum Colmarensium, in the collection, entitled *Rerum Germanicarum Scriptores operâ Christiani Urstitii* Francofurdi, 1585, *in folio.*

The Great Belgian Chronicle—*Magnum Chronicon Belgicum, collectore anonymo Canonico regulari*, in the German history published at Ratisbon, already mentioned.

Chronicon Engelhusii, in *Scriptores Rerum Brunswicensium.*

Joannis Trithemii ; Annales Hirsaugienses. Typis monasterii S. Galli. 1690, *in folio.*

Annales Flandriæ, in the historical collection, *Annales, sive Historiæ Rerum Belgicarum, à diversis auctoribus conscriptæ.* Francofurti ad Mænum, 1580, *in folio.*

Udalrici Onsorgii, Chronicon Bavariæ, in *Rerum Boicarum Scriptores, etc., edidit Andreas Felix Oefelius, Monacensis.* Augustæ Vindelicorum, 1763, *in folio.*

Cæli Anomalon, id est, de Cometis Scriptum, per Joannem Tackium. Gissæ-Hassorum, 1653, *in 4to.*

Chronicon Bohemiæ, auctore Neplacone, Opatovicensis in Bohemiâ Monasterii Abbate (*scriptum anno* 1360), which is found in *Scriptores Rerum Austriacarum, edente R. P. Hieronymo Pez.* Lipsiæ, 1721, *in folio.*

Chroniche di Messer Giovanni Villani, in Muratori's collection.

Chronica Augustensis, in *Rerum Germanicarum Scriptores ex Bibliothecâ Marquardi Freheri, editio tertia, curante Burcardo Gottelssio Struvio.* Argentorati, 1717, *in folio.*

Amalrici Augerii de Biterris, Actus Pontificum Romanorum ad Joannem XXII., seu ad annum 1321, in the German History published at Ratisbon.

Memoriale Potestatum Rhegiensium, in Muratori's great collection.

Memoires de l'Academie des Sciences, 1760. Paris.

Monarchiæ Sinicæ Synopsis Chronologica, in the second volume of the Voyages of Thévenot. Paris, 1696, *in folio.*

The preceding references were given by M. Pingré, in his elaborate work, the "*Cometographie,*" t. 1. I may add to them the following :—

Joannis Hevelii Cometographia. Gedani, 1668, *in folio.*

Stanislai de Lubienietz, Lubienicii, Theatrum Cometicum. Lugduni-Batavorum, 1681, *in folio.*

Matthæi Paris, Angli, Historia Major. London, 1640, *in folio.*

Chronicon Claustro-Neoburgense, in the History entitled *Scriptores Rerum Austriacarum, etc.*

Connaissance des Temps, 1846. Appendix.

Besides these works might be mentioned a great number of cometographies, ancient and modern; but they only contain extracts from chronicles and histories, the titles of which are here given.

CHAPTER II.

On the Elements of the Orbit of the Comet of 1264.

In Vol. XLVII. of the Philosophical Transactions, Mr. Dunthorne gave elements for the Comet of 1264, founded principally on the authority of Friar Giles's manuscript, already quoted. The other authorities consulted were the "*Chronicon Sampetrinum Erphurtense,*" published in the third volume of Menkenius's collection of Saxon writers, and the Chronicle of John Vitoduranus, found in the first volume of the work, "*Corpus Historicum Medii Ævi,* editum à Joanne Georgio Eccardo, Lipsiæ, 1723." I have before noticed the contradiction in the account furnished by Mr. Dunthorne's chief authority: it will, however, be interesting to examine how his elements represent the circumstances mentioned by historians. The orbit assigned by Mr. Dunthorne is as follows:—

Perihelion Passage, 1264.....	July 6d. 8h.
Longitude of the Perihelion	291° 0′
Ascending Node	169 0
Inclination to the Ecliptic	36 30
Logarithm of Perihelion distance	9.64836

Motion, direct.

The comet's geocentric path, deduced from these elements, will be as subjoined.—

1264.	Comet's Geocentric Longitude.	Comet's Geocentric Latitude.
July..... 1, Evening ..	♋ 25° 57′	22° 13′ N.
,, 14, Morning ..	7 58	10 49
,, 18, ...	4 8	5 2

1264.			Comet's Geocentric Longitude.			Comet's Geocentric Latitude.		
July	22	Morning ..	♋	1°	40′	0°	30′	S.
,,	26	.....		0	16	5	31	
,,	30	.....	♊	29	35	9	59	
August ..	3	.....		29	21	13	58	
,,	7	.....		29	23	17	30	
,,	11	.....		29	34	20	42	
,,	15	.....		29	49	23	39	
,,	19	.....	♋	0	2	26	23	
,,	23	.....		0	12	28	58	
,,	27	.....		0	17	31	24	
,,	31	.....		0	16	33	42	
September	4	.....		0	1	35	56	
,,	8	.....	♊	29	36	38	4	
,,	12	.....		29	0	40	6	
,,	16	.....		28	12	42	4	
,,	20	.....		27	7	43	55	
,,	24	.....		25	46	45	41	
,,	28	.....		24	6	47	18	
October ..	3	.....		21	44	49	8	

Mr. Dunthorne then observes that, on July 1st the comet might be seen in the evening after sun-set; but, perhaps, the tail might not be conspicuous enough to occasion its being much noticed in its descent towards the perihelion. On July 8th it would have the same right ascension as the sun, and nearly 41½° north declination, so that, in the south of France, it set about twilight, and did not rise till daybreak; and therefore might escape notice either morning or evening, about this period.

July 14th to 30th, in the southern parts of Europe, it rose before daybreak, after the morning star. On September 8th, it was between Canis Major and Orion.

It is pretty evident that Mr. Dunthorne had not seen the poem of Thierri, which expressly states that the longitude of the comet was in 30° of Cancer when the sun had passed the

11th degree of Leo; and this position is confirmed by the Chinese annals. The longitude of the sun would be 131° on the morning of the 27th of July, and the comet must have had a north latitude of many degrees to be conspicuous at an elongation of 11° only in longitude. Mr. Dunthorne's orbit places it, on this day, in the first degree of Cancer, with a south latitude of between 6° and 7°; differing entirely from Thierri's narration. The Chinese records shew that the motion of the comet, in right ascension, would extend over at least 40°, from the sidereal division *Lieou* to that of *Tsan*, between July 26th and August 19th: this is likewise irreconcilable with Mr. Dunthorne's orbit, according to which, the change of right ascension, in this interval, would be scarcely sensible.

It is necessary to notice these discordances, because the elements given by Mr. Dunthorne figure in all our catalogues of comets, and differ materially from those calculated for the comet of 1556. With such an authority as Friar Giles, we can hardly be surprised that he should not have found an orbit to represent accurately the circumstances related by more consistent authors.

In the memoirs of the Academy of Sciences at Paris, for 1760, is a valuable paper, by M. Pingré, on the Comet of 1264. After an impartial discussion of the various accounts furnished by historians, he arrived at the following conclusions:

1st. The comet does not appear to have been observed before the 17th or before the 14th of July: it is therefore probable that it was not easily to be seen before this time.

2nd. On July 14th or 17th, it was seen only in a few places. We may conjecture that some obstacle, either its distance from the earth or small elongation from the sun, did not permit its being observed so distinctly as since that time.

3rd. It then appeared in the evening, after sunset.

4th. One author, not contemporary, but ancient, says it began to be observed on July 22nd: it might have been by a few persons only, since other ancient authors do not mention the circumstance.

5th. On July 25th, it was more visible, as some other writers date its appearance on this day. About the end of July it was seen in almost every part.

6th. On the morning of July 27th, the sun being in 11° and more of Leo, the comet was observed in 30° of Cancer. Its elongation was not more than 11°: it must, therefore, have had a great north latitude, to allow of its being seen above the horizon one hour and a half or two hours before sunrise.

7th. About August 1st, it appeared two hours before sunrise.

8th. At first, it rose after the planet Venus; shortly, by a rapid motion, it passed that planet, and preceded it considerably.

9th. It had two movements: the one in longitude, from east to west; the other in latitude, from north to south; and it appears that these motions were nearly equal.

10th. Its latitude varied 40° and more in two months; and more than 50° during the whole appearance.

11th. In a few days it moved from the 8th degree of Cancer into Gemini: it was seen between Orion and Canis Minor. September 22nd, it passed the meridian before day-break: finally, it traversed Orion.

12th. The tail diminished in breadth, but increased greatly in length.

13th. It disappeared about the beginning of October; the distance from the earth having probably become too great to allow of its being longer observed.

All these circumstances, Pingré explained satisfactorily by the following elements:—

Perihelion Passage, 1264. .	July, 17d. 6h. 10m. M.T. at Paris.		
Longitude of the Perihelion	275°	45′	} Equinox of 1264.
Ascending Node	178	45	
Inclination to the Ecliptic .	30	25	
Logarithm of Perihelion distance.	9.61364		

Heliocentric motion, direct.

From these elements, Pingré computed the geocentric places of the comet during the time of its visibility: the sun's places were calculated from Halley's Tables, and the longitudes and latitudes are adapted to noon, mean time in London.

On July 7th, the comet's longitude was ☊ 18° 40′, and its latitude 10° 13′ north. The sun was then in ♋ 22° 13′; so that the comet's elongation was not great. Its distance from the earth = 0.97, and it would not be easily discovered at this period.

On July 17th, the longitude of the comet was ☊ 14° 34′, and its latitude 16° 9′ north. The sun was in ☊ 1° 47′. The comet would, therefore, rise nearly at the same time as the sun, and set about two hours after him: the distance from the earth = 0.74. It was certainly visible in the evening, and might have been seen on July 14th, but, from its position in the twilight and near the horizon, would easily escape the greater number of observers.

On the 22nd of July, the comet was in ☊ 7° 58′, latitude 16° 28′ north, and the sun in ☊ 6° 35′. On account of its high latitude, it would be visible both morning and evening, but more conspicuously in the evening. Proximity to the horizon would still prevent general observation.

July 27. Comet in ♋ 29° 33′, latitude 14° 19′ north: sun in ☊ 11° 23′. About 4 A. M., the longitude of the comet would be ♋ 30°, as Thierri affirms. The distance from the earth was nearly three-fifths of the mean distance of the earth from the sun. About this time, it would be

well seen, rising an hour and a half before the sun, with a tail directed toward the west. In August it receded from the earth and sun; but, since it approached its quadrature, the tail would probably increase in apparent length.

On July 28th, the comet being in ♋ 27° 53′, with a north latitude of 13° 36′, and Venus in ♋ 4° 37′, would rise after that planet, or at least follow it.

August 7th. Comet in ♋ 13° 39′; Venus in ♋ 16° 20′. The comet had lately passed the planet.

On August 27th; longitude ♊ 26° 10′, latitude 16° 19′, south. Thus, in a few days, it had retrograded from the eighth degree of Cancer into Gemini; and, about this time, would be between Canis Minor and Orion.

On the 6th of September, the longitude being ♊ 18° 43′, latitude 24° 9′ south, it would be very near the Girdle of Orion, and in quadrature with the sun.

On September 16th (comet in ♊ 10° 23′, latitude 30° 43′ south), it was two degrees distant from the foot of Orion. Its distance from the earth was about 0.75. It would begin to diminish in brilliancy about this time; indeed, many authors terminate its appearance at the present date, or thereabouts.

September 22nd, being in ♊ 5° 30′, it would pass the meridian about 4½h. A.M., or before daybreak.

September 26th, it was in ♊ 1° 22′, with 35° 26′ south latitude; and had therefore traversed Orion: distance from the earth = 0.8.

October 6th (comet in ♉ 21° 20′, with 37° 44′ south latitude), the distance from the earth was 0.9. The comet was near the horizon. Since July 17th, it had passed over more than 50° in latitude; and more than 40° since August 3rd.

Among several other sets of elements tried by Pingré was the following:

Perihelion passage, 1264	July, 16d. 0h.		
Longitude of the perihelion..	272°	30′	} Equinox of 1264.
Ascending Node	175	30	
Inclination of Orbit	30	25	
Logarithm of perihelion distance.....	9.63347		

Heliocentric motion, direct.

These elements approach nearer to those of the Comet of 1556 than the first set; but, according to the last orbit, the comet should have retrograded as far as Eridanus, 18° or 20° beyond Orion. As Thierri does not mention this circumstance, Pingré considered the first orbit preferable.

I have given this detail respecting Pingré's orbits, and his comparison with the relations of various historians, as the only way of enabling the reader to judge how far the elements represent recorded facts, and what degree of probability is to be attached to the supposed identity of this comet with that of 1556, at least as far as can be deduced from his investigation.

The celebrated cometographer does not mention the Chinese observations as among those on which his orbits were founded. At the time he wrote, the only available account of them was contained in a manuscript of Father Gaubil's, then preserved in the "Depôt de la Marine" at Paris, and now in the library of the Observatory in that city. But Gaubil's version does not furnish us with the valuable and definite particulars in the Translation by M. Edouard Biot, published in the Appendix to the "*Connaissance des Temps* for 1846. Referring to the first volume of Pingré's Cometography, we have the following extract from the manuscript: "On day *Kia-su,* seventh moon (July 26th), the comet was in the constellation *Lieou* (head of Hydra); the length of the tail was 100°. On day *Ki-mao* (July 31st), it had retrograded: it was observed in the constellation *Yu-Kouei* (β, η, γ, δ Cancri). On day *Sin-sse* (August 2nd), the

comet was in the constellation *Tsing* (Feet of Gemini): it was seen afterwards in the constellation *Tsan* (Cross of Orion). At the end of the eighth moon its rays diminished. It was seen during four months." This account is stated by Gaubil to be taken from the annals of the reigning family in China—that is, of the dynasty *Ming*. On comparing it with M. Biot's translation, we find Gaubil has read "constellation" for "sidereal division," and has omitted to mention the dates August 17th and 19th, which are most important, as well as the fact that the comet was situated in the "middle of the degrees" of *Tsan*, on the latter day. If we compute from Pingré's first orbit, we shall find for the morning of August 19th in China, the comet's right ascension = $92\frac{1}{2}°$, but its observed R. A. was 78°, differing between 14° and 15° from the position given by his elements.

There can now be no doubt that the comet retrograded some distance into Eridanus, though no mention is made of the circumstance by European writers, or in the Chinese annals. We know that it passed from *Lieou* to *Tsan*, or from Leo to Orion, between the 26th of July and the 19th of August; nevertheless, it continued visible, according to European historians, until the beginning of October, or during four moons, as the Chinese tell us. I have satisfied myself, by actual calculation from the observations of 1264, that the comet would retrograde considerably beyond Orion. The omission of all reference to this circumstance by the Chinese is not at all remarkable: they do not profess to give us an account of its movements or position, except during the seventh moon. Nor do I think we need be surprised that European historians are silent on the subject. The information afforded by them is very scanty; and the remark, that "the comet finally traversed Orion," does not convey any idea how far past Orion it may have retrograded. Pingré was evidently disposed to interpret this phrase

literally; but Eridanus is by no means a conspicuous constellation in these latitudes,—at any rate, as compared with Orion. And the historian having stated that the comet traversed Orion, we may easily imagine he would not follow it into a neighbourhood characterised by few bright stars, but rather content himself with recording its passage through the more remarkable constellations. Orion, as one of the most ancient of the asterisms, would be familiar to every star-gazer, even at the remote epoch of which I write; but the case would be far different with Eridanus. We have, however, more conclusive evidence from the fact, that it appears very difficult to represent satisfactorily all the particulars related by European historians, combined with those recorded in the annals of China, without admitting the retrogradation into Eridanus towards the end of the comet's appearance.

I place particular stress on this point, because it is of high importance in reference to the identity of our comet with that of 1556. If we carry back the elements of the latter comet, deduced from the observations of Fabricius, to 1264, and fix the time of perihelion, either from the narration of Thierri, or the Chinese observation of August 19th, we shall find that the comet would move some distance beyond Orion, through Eridanus, during the latter half of the month of September.

For the convenience of any person who may hereafter make calculations respecting the comet in 1264, I add a table shewing the true longitude of the sun, and the logarithms of the earth's radii-vectores for every fifth midnight, mean-time at Greenwich, Old Style. These values are computed from the last Solar Tables, published by Carlini, in the Milan Ephemeris for 1833, which, I may remark, are the most exact tables of the sun we now possess.

1264.	Sun's Longitude.	Logarithm of Earth's Radius-vector.
July 17	122° 15′,2	0.00619
,, 22	127 2 ,9	0.00585
,, 27	131 51 ,0	0.00546
August .. 1	136 39 ,7	0.00501
,, 6	141 28 ,9	0.00453
,, 11	146 18 ,6	0.00402
,, 16	151 9 ,1	0.00350
,, 21	156 0 ,5	0.00295
,, 26	160 52 ,7	0.00236
,, 31	165 45 ,6	0.00174
September 5	170 39 ,2	0.00111
,, 10	175 33 ,6	0.00049
,, 15	180 29 ,0	9.99986
,, 20	185 25 ,3	9.99924
,, 25	190 22 ,6	9.99861
,, 30	195 20 ,6	9.99797
October.. 5	200 19 ,4	9.99735

CHAPTER III.

Description of the Comet of 1556.

The Comet of 1556 appears to have been seen in some places before the end of February; but it was not generally observed until the middle of the first week in March. Its apparent diameter was equal to half that of the moon, and the tail resembled "the flame of a torch agitated by the wind,"—an expression doubtless referring to the coruscations which are sometimes visible in the tails of comets. Cornelius Gemma (son of the celebrated Gemma Frisius) says, the head of the comet, when it first appeared, was fully as large as Jupiter; its colour resembled that of Mars, the ruddiness fading lastly into a pallid hue. Hevelius, citing Cyprian Leovitius, says "Sed color in extremitate fuit semper pallidus, lividus, et quasi plumbeus, sicque sensim versùs caput Stellæ lucidior apparuit, ut eum verè naturâ Saturni et Mercurii constare dicas." Gemma saw the tail about 4° long.

The course of the comet of 1556 was observed by Paul Fabricius, a mathematician and physician at the court of the Emperor Charles V. of Austria. M. Pingré sought in vain for the original observations; the only vestige of them, which he could discover, being a small rough chart found in the works of Lycosthenes and other authors: Lalande, in his "*Bibliographie,*" mentions a publication by Fabricius relative to the comet, printed at Nurnberg in 1556; probably, if this work could be recovered, we might be in possession of more

definite information with respect to his observations, but I am not aware that it has been found in any library; we must therefore have recourse to the chart, which is given in the curious book of Prodigies, Omens, &c., by Conrad Wolfhardt, better known as Lycosthenes. I have had the opportunity of consulting a copy of this somewhat rare compilation, recently presented by Mr. Williams to the Royal Astronomical Society; and I shall here give the results of a pretty careful examination of the diagram shewing the apparent path of the comet, which will be found to differ on one or two points from the detail furnished by M. Pingré in his "*Cometographie.*"

On March 4th, according to the chart, the comet was in 8° of Libra and in the equator; consequently its latitude would be about 3° 30′ north.

On the 5th, the longitude had diminished a little, and might be 7° of Libra: the latitude was rather less than that of ζ Virginis. The comet was nearly equidistant from γ and ζ in that constellation, and somewhat above a line joining them: the latitude would be about 7° north. Pingré has read γ and θ; but one of the stars is evidently ζ. I detected this error before I had seen the chart, from a general examination of the apparent path, and proposed to substitute δ for θ.

On March 6th, the comet was higher than δ but not so high as ϵ in Virgo, as respects the latitude. It was nearly in the bisection of lines, the one drawn through η and δ and the other through ϵ and ζ. Longitude in 6° of Libra; latitude about 12° north.

On the 7th it was in 5° of Libra, and had the same declination as ϵ Virginis; consequently the north latitude would be about 17°.

On the 8th the longitude did not differ much from that of the preceeding day in 5° of Libra: the declination was

nearly the same as that of ζ Bootis, which will give a north latitude of about 23°.

March 9th, the comet had passed the tropic of Cancer, and was in $4\frac{1}{2}$° of Libra: its latitude was nearly the same as that of Arcturus, or from 30° to 31°.

March 10th, in 4° of Libra, the latitude was somewhat less than that of ε Bootis, and might be about 38° north.

On the 11th the comet was in 3° of Libra, with about 44° north latitude, and on the 12th in 1° of that sign, with a latitude of 47° or 48°. I think there can be little doubt that the positions for the 11th and 12th refer to the *mornings* of those days instead of the evenings as on previous dates; otherwise the intervals will be very irregular.

On March 13th, the comet had passed over more than 30° of longitude since the preceeding observations, and was then in 0° Virgo, distant 10° or 12° from the pole of the ecliptic. No date is affixed to this position in the map, but it clearly refers to the 13th: latitude 78° or 80° north.

On the 14th the comet had retrograded through Leo, Cancer, and Gemini, and was seen this day at the commencement of the latter sign, or in 0° ♊; It was nearer the pole of the ecliptic than on the 13th, having a north latitude of 81° or 82°.

On March 15th, Fabricius observed the comet for the last time, in about 20° of Aries, with a north latitude of 72° or 74°.

Cornelius Gemma, in his work, "*De Naturæ Divinis Characterismis,*" published at Antwerp in 1575, gives us a somewhat lengthy description of the Comet of 1556.

"Occurrit imprimis dirum illud cometæ portentum, quod biennio ferè post terræ motus apparuit, anno Salutis 1556, à principio Martii (ut plures asserunt), usque ad 23 Aprilis. Paulus Fabritius hujus cursum observavit quàm diligentissimè sed tantùm à 4 Martii usque ad 13. Equidem tum paulo supinior in mathematicis adverti animum,

sed non æquè ad singulos dies industriam observationis adhibui; hoc tamen à me notatum repperi, tertiâ Martii non procul ab ipso zodiaco constitisse circa Libram; caudâ prælongâ, versùs occasum exporrecta, secundùm rectam lineam à solis corpore per cometæ caput in oppositam partem. Paulò antè quam solis vicinia ejus adspectum nobis eriperet, itinere propemodùm per polum zodiaci facto ad Sedem Cassiopeæ pervenisse circa April 18 diem. Ego cum postremò locum instrumentis adhibitis explorassem, reperi non procul a signiferi polo, sed tamen in Leonis dodecatemorio, si ad zodiacum referatur. Qui rectiùs explorarunt, censent expirasse non procul ab eo loco, quem nunc obtinet sydus novum, idque potius reor; cum alia quadam tabella seorsim invenerim scriptum manibus meis spectatum esse cometam usque ad 23 Aprilis diem. Credo et caput ipsius antequam se nobis obtulerit, signiferum pertransisse. Cœpit autem ab initio Martii ex Libræ signo moveri sursùm versùs polum: obliquè verò et in posteriora secundùm longitudinem versùs principium Libræ, pergebat interdum 8 aut 9 gradus in latitudinem, nunc paulò tardior nunc concitatior. Tertio die 6 tantum gradibus distabat à Spicâ, recta linea prorsùs inter Spicam, et inferiorem sub Cingulo Virginis, caudâ spectante versùs alam sinistram. Hinc ferè secundum rectam lineam scandens, usque ad tropicum venit seu declin. 23° graduum circa octavam diem. Tum ad aliquot gradus retrogressa, repentè versùs finem Leonis, aliam rectam lineam discursus in latitudinem, auspicata est usque ad vigesimum tertium discurrens rectà ad zodiaci polum (à quo non procul abfuit) raptim per omnes angulos signorum Leonis, Cancri, Geminorum pervagata, donec ad alterum orbis quadrantem, signumque Tauri non procul à Cassiopeâ pervenisset. Quanquam nobis nec eo tempore deflagrasse videatur, sed ob viciniam solis (cùm manè tantum hora tertia spectaretur), obscuratam ab occulis evanuisse. Movebatur multò citatiùs circa polos, neque jam in fine apparationis suæ, multum diminutus magnitudine videbatur. Cauda semper Hispaniam versùs in principio, post magis magisque versus occiduam plagam ac postremò mense Aprilis, exactissimè versus zodiaci polum, sole tunc cum sydere Martis posito in rectam lineam cum cometæ corpore et zodiaci polo."*

Gemma here speaks of the disappearance of the comet on April 23rd, in Cassiopea, owing to its proximity to the sun,

* See Appendix, page 77.

which, as Pingré has remarked, is hardly intelligible. He observed at Louvain: but Cassiopea never descends below the horizon of that place; consequently there must be some error in his description, as the sun's rays are not visible all night during the month of April.

Abraham Rockemback, in his "*Exempla Cometarum,*" has the following passage: "A. C. 1556. A comet was seen from the 8th of March (others place it at the beginning or 5th day of March) until the end of the month, which afterwards passed with a very rapid motion from Spica Virginis to Bootes, or Ursa Major and Minor, thence again to Cepheus, and directing its course towards the planet Saturn, at that time in Aries, preceded the Sun before Easter-day, and was sometimes observed before sun-rise." In 1556, Easter-day fell on April 5th.

A work entitled "*Senatûs Populique Genuensis Historia, auctore P. Bizaro, Sentinate, &c.,*" has a notice of our comet. "In the month of March of the same year, 1556, on the 4th day, a great and brilliant star began to be perceived in 8° of Libra, and in opposition to Mars, training after it a flaming tail of great extent. It burned nearly twelve days." The long and "portentous" tail was first directed eastwards, but, after the comet had moved rapidly to the north, it was pointed towards the south.

John Hommelius describes the appearance of the comet in 1556. I quote from the Cometography of Hevelius. "On March 5th it was situate near the left wing of Virgo, above Spica; on the 8th, below the knee of Bootes; and on the 9th, near Arcturus: it was seen to approach, as though in the arc of a great circle—that is, in a very straight path,—the north pole of the ecliptic; and then, in the space of one day, it passed through more than 15° of a celestial circle. Moreover, ascending towards the north pole of the zodiac, leaving it to the right, it approached the pole of the equator with great

rapidity; and thence descending *quasi ex culmine*, it moved to the planet Saturn, which was then in Aries."

Camerarius describes the course followed by the comet at some length; but his account adds little to the particulars already extracted from other authorities. It passed from Virgo to Pisces, and disappeared under the latter sign, remaining for a long time in the constellation Andromeda. As it drew near the planet Saturn, its apparent motion became gradually slower.

The comet was observed in Europe until the latter part of April. Lycosthenes says it was seen in Germany until the middle of that month.

Guicciardini, Spondanus, Bizarus, Hennenfeld, and other historians, assure us that the Emperor Charles V. of Austria was greatly alarmed at the appearance of this comet. He looked upon it as a sign of his approaching death, and expressed his fears in the following line:

His ergo indiciis me mea fata vocant.

Or, as Comier's French verse runs—

Par la triste comete,
Qui brille sur ma tete,
Je connois que les cieux
M'appellent de ces lieux.

This strange alarm contributed, historians say, to induce the Emperor to cede the imperial crown to his son Ferdinand, the crown of Spain having already been renounced in favour of his son Philip.

The comet of 1556 was observed in China. We have the following account in the annals of the Ming dynasty, extracted from the supplement to the catalogue of Ma-tuoan-lin. In the thirty-fifth year of the period *Kia-tsing* on day *Keng-tchin* of the first moon, (March 1) a comet was seen near *Tsin-hien*, (χ, ψ, Virginis): it was about 1° long; it pointed towards the

south-west; gradually it increased to about 3°; it swept over the north-east of *Tse-siang* (δ Virginis) of the wall of *Thai-wei*. It entered *Tse-wei*, ("circle of perpetual visibility,") and touched the *Thien-tchoang* (small stars near θ and ι Draconis). On the second day of the fourth moon (or about May 10th) it disappeared. All this agrees very well with the course assigned by the chart of Fabricius. *Thai-wei* is the name given by the Chinese to the region of the heavens surrounding β Leonis, and contains stars in Leo and Virgo. One of the boundaries, or, in Chinese phraseology, one of the "walls" of *Thai-wei* is formed by η, γ, δ, and ε in Virgo. When a comet is said to enter *Tse-wei*, we know that its declination would be greater than the co-latitude of the place of observation, or it would remain continually above the horizon.

The following are the titles of works which have particulars relating to the Comet of 1556.

De Naturæ Divinis Characterismis, auctore Cornelio Gemma, Regio Medicinæ Professore. Antverpiæ, 1575, *in* 8vo.

Hieronymii Cardani in Ptolemæum de Astrorum Judiciis. Lyons, 1663. In the third volume—*De Rerum Varietate.*

Achillis Pirmini Gassari Annales Augstburgenses. In Menkenius' Collection of Saxon Writers.

Guilielmi Gilberti Colcestrensis, Medici Regii, De Mundo Nostro Sublunari Philosophia Nova. Amstelodami, 1651, *in* 4to.

Conradi Lycosthenis Prodigiorum et Ostentorum Chronicon. Basileæ, 1557, *in folio.*

Histori Abdicationis Caroli V. Imperatoris, in a work published at Basle in 1574, entitled *Historicum Opus.*

Senatûs Populique Genuensis Historia, auctore P. Bizaro, Sentinate. Antverpiæ, 1579, *in folio.*

Nicolai Henelii ab Hennenfeld, Annales Silesiæ, found in a work entitled *Silesiacarum Rerum Scriptores, operâ Friderici-Wilhelmi Sommersberg.* Lipsiæ, 1729, *in folio.*

Joannis Hevelii Cometographia. Gedani, 1668, *in folio.*

Jacobi Augusti Thuani, Historiæ sui temporis. London, 1733, *folio.*

Josephi Ripamontii Historiarum, à Philippo II. regnante, found in *Thesaurus Antiquitatum et Historiarum Italiæ, &c.* See under the Comet of 1264,

Joachimi Camerarii, de eorum, qui Cometæ dicuntur, Nominibus, Naturâ, etc., Disputatio. Lipsiæ, 1558, *in* 8*vo.*

Georgii Fabricii, Chemnicensis, Rerum Germaniæ Magnæ et Saxoniæ Memorabilium. Lipsiæ, 1609, *in folio.*

Abrahami Rockembackii, Exempla Cometarum.

Ludovici Guicciardini, de Rebus Memorabilibus, quæ in Europâ et maximé in Belgio occiderunt, ab anno 1530, *ad annum* 1560, in the work *Annales, sive Historiæ Rerum Belgicarum, etc.* See under Comet of 1264.

Joannis Isaci Pontani Historia Gelrica. Hardervici-Gelrorum, 1639, *in folio.*

Annalium Baronii Continuatio, per Henricum Spondanum. Paris, 1641, *folio.*

Cypriani Leovitii, de Conjunctionibus Magnis, Eclipsibus, et Cometis, etc., Marpurgi, 1618, *in* 4*to.*

Ludovici Cavitelli Cremonenses Annales, in *Thesaurus Antiq., etc.*

Bartholomæi Keckermanni Systhema Physicum, libr. VI. Genevæ 1614, *in folio.*

La Nature et Présage des Comètes, par Claude Comiers. Lyons, 1665, *in* 12*mo.*

J. B. Riccioli, Soc. J. Almagestum Novum. Bononiæ, 1651, *folio.*

Valentini Engelhardt Observatio et Significatio Cometæ anni 1556. Erfurt, 4to.

Elegia Cometâ qui apparuit mense Martio 1556, *à Maratino Mylio Annaebergensi.* Viennæ, 4*to.*

De Cometâ et Duabus Eclipsibus anni 1556, *Elegia.* (Baldazar Schulzius) Lipsiæ, 4*to.*

Adami Ursini Noribergensis Prognosticatio von dem Cometem 1556. Erfurt, 4*to.*

Other works might be added, which contain repetitions of the statements in previous publications; such as the "*Theatrum Cometicum,*" of Lubienietski, the works of Cæsius, Zahn, Hommelius, &c.

CHAPTER IV.

On the Orbit of the Comet of 1556.

The elements of this Comet were first calculated by the celebrated Halley and published in his "*Synopsis of Cometary Astronomy*," the appearance of which formed an epoch in the history of the science. He remarks that the elements are not so certain as those of some of the other comets in his table; the observations being made neither with sufficient instruments nor due care, and by no means to be reconciled with any regular calculation. Probably, therefore, Halley had no further knowledge of the observations of Paul Fabricius than is given in the chart already described. His orbit for the comet of 1556 is as follows:—

Perihelion Passage, 1556, April 21d. 20h. 3m. G.M.T. (Julian Style.)

Longitude of the Perihelion..	278°	50′,0	} Equinox of 1556.
Ascending Node	175	42 ,0	
Inclination of the Orbit	32	6 ,5	

Logarithm of Perihelion distance 9.666424

Heliocentric motion, direct.

Some years since I was induced to examine how far the apparent path calculated from Halley's elements would agree with the particulars related by Pingré in his Cometography. I ascertained that the observation of March 5th, as there given, presented a marked disagreement; while the position on another date accorded no better with the theoretical place. Not expecting to find the observation of March 5th incorrectly read off from the chart, I adopted the place for that day as a

starting point, and arrived at two sets of elements, representing only tolerably well the positions subsequent to the 5th, but quite irreconcilable with the observations of March 3rd and 4th. The results of my investigation were published in No. 493 of Professor Schumacher's Astronomische Nachrichten, from which I transcribe the two orbits, premising that the first appeared to be most satisfactory.

	Elements I.	Elements II.
Perihelion Passage 1556 Greenwich Mean Time, Julian Style	April 21,8012	April 20,9972
Longitude of the Perihelion . .	267° 37′,7	262° 49′,1
Ascending Node	176 33 ,8	176 29 ,1
Inclination of the Orbit	36 11 ,4	36 39 ,2
Logarithm of Perihelion Distance .	9.75246	9.78254
Heliocentric motion	Direct.	Direct.

As the cause of the discrepancies between my elements and those of Halley has now become sufficiently evident, it will be unnecessary to lay any stress upon them. Unfortunately I did not discover the source of the anomaly until it was too late to prevent the publication of the two orbits in several catalogues recently printed. Now that I have been enabled to consult the chart exhibiting the observations of Fabricius, I am satisfied both must be rejected.

It afterwards occurred to me that it might be possible to reconcile the observation of March 5th with the rest, on supposing that Pingré had given the name of one of the stars wrong. Instead of γ Virginis I substituted δ, and by a trigonometrical calculation (for which however there was no occasion) I found the longitude of the comet $= 188° 41'$ and the latitude $+ 5° 13'$ agreeing much better with the course indicated by the other observations. An examination of the chart in Lycosthenes has shewn that, instead of θ Virginis, we must read ζ, a correction which brings the observation of March 5th into very fair agreement with the others.

On April 9th, 1847, I communicated to the Royal Astronomical Society a second paper on this comet; it was printed in the "Monthly Notice" for that date. After a brief sketch of the history of the comet in 1264 and 1556, I gave the following set of elements, which appeared to me pretty satisfactory at the time, and which I have since found to agree remarkably well with the chart of Fabricius.

Perihelion Passage, 1556, April 22.0233 G.M.T. Julian Style.
Longitude of the Perihelion.. 274° 14′,9 } Equinox of 1556
Ascending Node ..... 175 25 ,8 } March 10.
Inclination of the Orbit..... 30 12 ,2
Logarithm of Perihelion Distance 9.70323
Heliocentric motion, direct.

Calculating from these elements, for Greenwich mean midnight, we have the following ephemeris for comparison with the apparent path of the comet, which I have described in a former section.

1556.		Comet's Geocentric Longitude	Comet's Geocentric Latitude.	Distance from Sun.	Distance from the Earth.
March	3	188°,2	+ 1°,2	1.184	0.193
	4	188 ,0	3 ,7	1.167	0.175
	5	187 ,7	6 ,8	1.150	0.157
	6	187 ,4	10 ,6	1.133	0.140
	7	186 ,9	15 ,5	1.116	0.124
	8	186 ,2	21 ,7	1.099	0.109
	9	185 ,3	29 ,8	1.082	0.096
	10	183 ,8	40 ,2	1.065	0.085
	11	181 ,2	52 ,8	1.047	0.078
	12	175 ,4	67 ,1	1.030	0.075
	13	153 ,6	80 ,5	1.013	0.078
	14	55 ,3	82 ,5	0.996	0.085
	15	27 ,3	73 ,4	0.979	0.095
	16	20 ,6	65 ,5	0.962	0.108
	17	17 ,7	59 ,3	0.945	0.122
	27	12 ,3	35 ,0	0.777	0.302
April	6	12 ,1	27 ,0	0.625	0.505
	16	14 ,2	20 ,5	0.522	0.733
	26	19 ,2	13 ,9	0.516	0.974

I question whether it will be possible to obtain a much better agreement between calculation and observation than is here presented. On March 4th the comet would be in 8° of Libra and in the Equator; on the 5th it would be nearly equidistant from γ and ζ Virginis and a little above the line joining them. On the 7th its declination would be nearly the same as that of ϵ Virginis. Between the 8th and 9th it had passed the Tropic of Cancer. On the evening of the 10th the latitude would be somewhat less than that of ϵ Bootis. On the morning of the 11th it might be seen in 3° of Libra with a north latitude of 44°. On the 12th, early in the morning, it would be situated in 1° of Libra, but with a latitude some degrees greater than that I have read off from the chart. I must remark that the path laid down on the map about the 12th is somewhat distorted, which will account for this difference. At midnight, March 13th, the comet would not be more than 10° distant from the Pole of the Ecliptic, and on the 14th would be still nearer to the Pole, in the commencement of Gemini. On the 15th Fabricius saw it in about 20° of Aries, latitude + 73°: my elements place it in 27° of that sign with the same latitude. The difference is quite immaterial as regards the accuracy of the orbit. It is not possible to read off the chart with any great degree of exactness, particularly in this position.

I think we may therefore assume these elements as giving a very fair approximation to the orbit of the comet of 1556. They differ but slightly from Halley's, the inclination being somewhat less and the perihelion distance a little greater.

It will now be interesting to ascertain how far the orbit can be made to represent the observations of the comet of 1264. Supposing that the effect of perturbation between 1556 and 1264 was not very great, we ought, on the hypothesis of identity, to obtain a near agreement. The first point to settle is the time of perihelion passage; and we have two observations

suitable for this purpose. The first is that of Thierri, who places the comet in 30° of Cancer, when the Sun had passed the 11th degree of Leo. The second is the Chinese observation of August 19th, according to which the comet was situated in the "middle of the degrees of *Tsan*," or in R. A 78°. Thierri's observation being rather more definite than the other, I adopt it for fixing the epoch of perihelion, and find July 13.42, Greenwich mean time, Julian Style.

Reducing the perihelion and node to 1264, by the application of precession, we shall have the following geocentric positions of the comet.—

1264.		Geocentric Longitude.	Geocentric Latitude.	Distance from Sun.	Distance from Earth.
July	7	138°,2	+ 18°,2	0.53	0.82
	17	132 ,6	22 ,2	0.51	0.62
	22	126 ,5	21 ,9	0.55	0.55
	27	118 ,6	20 ,2	0.61	0.48
August..	6	101 ,2	10 ,3	0.75	0.41
	16	85 ,4	— 3 ,8	0.92	0.39
	26	70 ,8	17 ,2	1.09	0.42
September	5	56 ,6	27 ,1	1.26	0.48
	15	43 ,2	33 ,1	1.43	0.57
	25	31 ,6	35 ,4	1.59	0.69
October..	5	22 ,8	35 ,5	1.75	0.84

On comparing this path with such rough observations as we now possess, we shall find that the agreement is by no means unsatisfactory. The comet, though above the horizon, might not be easily discernible about July 7th, not only on account of the distance from the earth, but likewise from the presence of moonlight. On or about the 17th it would be more easily detected, and accordingly some writers date its first appearance at this time. On July 22nd it would doubtless be still brighter, the tail becoming longer. On the 26th it might be observed in the sidereal division *Lieou*, as one of the Chinese annalists affirms, and early in the morning of the

27th its longitude would be 30° of Cancer, the Sun having passed the 11th degree of Leo. July 31st, the comet, still retrograding, had reached *Yu-kouei*, and on August 2nd was situated in the sidereal division *Tsing*. On the 17th it had arrived at *Tsan*, and two days subsequently would be seen in about the "middle of the degrees" of that division; all which is closely borne out by the annals of China. At the end of August the comet would traverse the constellation Orion, and advance into Eridanus during the month of September, disappearing on the limits of Cetus and Eridanus at the beginning of October. I will leave the reader to compare more closely the calculated path with the course which the comet may be supposed to have followed, according to the descriptions given by historians, and collected in my first section. I shall merely remark that the agreement is, in my idea, sufficiently exact to render extremely probable the identity of the comets of 1264 and 1556: perhaps small variations in some of the elements might produce a closer accordance with one or two of the particulars related; and we must bear in mind that the orbit really described by the comet in 1264 is pretty certain to have been sensibly altered by perturbations during the 292 years which elapsed before the reappearance in 1556. As we assume the elements of the latter year for 1264, we must make some allowances for this circumstance.

The following table, exhibiting the sun's longitudes and logarithms of the earth's radii-vectores, which I have employed in my calculations relating to the comet of 1556, may be of service to some of my readers. The Solar Tables of Francesco Carlini in the Milan Ephemeris for 1833 have been used, and the epoch adopted is Greenwich mean midnight. The longitudes of the Sun are unaffected with aberration, though such a refinement is hardly necessary in the present case.

1556. Old Style.	Sun's True Longitude.	Logarithm of Earth's Radius vector.
March 3	353° 21′ 35″	9.9983643
4	354 21 8	9.9984909
5	355 20 40	9.9986179
6	356 20 10	9.9987451
7	357 19 39	9.9988721
8	358 19 5	9.9989988
9	359 18 30	9.9991254
10	0 17 53	9.9992516
11 .. .	1 17 13	9.9993775
12	2 16 32	9.9995028
13	3 15 48	9.9996277
14	4 15 2	9.9997521
15	5 14 14	9.9998757
16	6 13 24	9.9999993

It will be seen that this table is limited to the period over which the observations of Paul Fabricius extend.

CHAPTER V.

On the History of the Comet previous to the year 1264.

The identity of the Comet of 1264 with that of 1556 was inferred from a comparison of the elements deduced from the observations or descriptions left us in those years. It will now be interesting to examine whether any additional evidence in favour of this identity can be obtained from the records of previous ages. And here I may be permitted a few remarks on the Chinese authorities which I have already brought forward, and which it will be necessary for my present purpose to consult again. The grand collection of Ma-touan-lin contains the Chinese observations of comets from the year 613 B.C. until 1222 of the Christian era. A supplement continues the history down to 1644, since which year the official records have not been published. A translation of Ma-touan-lin's important document was inserted by M. de Guignes in t. X. of the *"Memoires des Savants Etrangers de l' Académie des Sciences"* The supplement was translated by M. Edouard Biot and published in the Appendix to the *"Connaissance des Temps"* for 1846. A grand collection of twenty-five principal historians of China also exists in several libraries at Paris: in these annals a section of astronomy is given under each dynasty, in which are found the cometary observations made during the various reigns. The great work of Ma-touan-lin contains a catalogue of what are called *"extraordinary stars,"* many of which were evidently comets, but, not exhibiting tails, did not

come under the class of objects so termed by the Chinese. M. Biot has also translated this document, and appended it to his edition of the supplement to Ma-touan-lin in the "*Connaissance des Temps,*" 1846. I have had before me the whole of these catalogues of comets and "*extraordinary stars.*"

Many persons, I believe, are disposed to look with much suspicion on observations purporting to have been made in the Celestial Empire, and there may be some grounds for this, so far as regards the observation of eclipses. The Chinese Emperors expected their astronomers to foretel the occurrence of these phenomena, and we hear of several unfortunate victims losing their heads through some error or omission in their predictions; amongst them figure *Ho* and *Hi*, whose discomfiture is described in the history of China by the learned missionary Duhalde. Many of these official astronomers appear to have been profoundly ignorant of the laws regulating the recurrence of eclipses; and it is not therefore very remarkable that imaginary eclipses should be somewhat numerous, for, being once entered in their almanacs for any coming year, they might easily find their way into the annals of the reigning dynasty as actual occurrences. But no objection of this kind can be urged against the Chinese observations of comets. They never pretended to foretel the appearance of these bodies. The heavens were considered as constituting a grand republic, the constellations were the provinces, the planets the ministers or governors, and the comets their messengers sent from time to time to convey orders. In this republic all events destined to take place in the Celestial Empire were ordained and settled, and this fanciful notion is alone sufficient to account for the attention paid to cometary astronomy by the Chinese. A strong proof of the authenticity of their observations of comets is deduced from the fact that, in many instances, the details afforded in the Chinese annals clear up the confusion existing in European accounts, and enable us to

come to some plausible results, where before all was contradiction and uncertainty. In numerous cases, when a comet's path has been described by European historians, the Chinese annals are found to be in close agreement. The comets of 1337, 1456 (Halley's), 1472, 1531, 1556, &c., may be cited amongst those which were observed in Europe and China—all the records agreeing in a remarkable manner.

I may mention one instance, where the Chinese annals appear to settle a date of some historical interest. The year of the birth of Mithridates is stated by Justin to have been distinguished by the appearance of a very large comet, which remained visible seventy days, and seemed to set the whole heavens in a blaze; its tail was four hours in rising, and the comet occupied a fourth part of the heavens. Now the year of the birth of Mithridates is left in some uncertainty by ancient writers: his death took place in B.C. 62. But authors differ as to his age; according to one account he was born B.C. 137, while Appianus dates his birth in 131. Referring to the Chinese catalogues, we find recorded the appearance of a grand comet in the sixth year of the reign of Hiao-vou-ty or the 43rd year of the 43rd cycle, answering to B.C. 134. It was seen from the end of July until the autumn; the tail extended from the N. E. to the mid-heaven, according to the version of Mailla, while Ma-touan-lin's figurative expression would even give it a greater length. Pingré recognises here the comet of Justin: it is highly improbable that two brilliant comets, with tails of prodigious length, should be visible about the same year and under the same circumstances, the one observed only in Europe, and the other only in China. Assuming therefore that the same body is referred to by Justin and the Chinese annalist, the birth of Mithridates is fixed in B.C. 134, which is the year assigned by Eutropius. Justin mentions another comet, observed when Mithridates ascended the throne; and the Chinese have recorded one in the

59th year of the 43rd cycle, or in the fourth year of Yven-cheou (4th moon), therefore in May, 118, B. C.; Ma-touan-lin says it appeared in the N. W., and elsewhere it is stated to have been as large as the sun: such a comet bears great analogy to that which, according to Justin, distinguished the commencement of the reign of Mithridates.

These remarks are addressed to the general reader, who may not have had an opportunity of examining the Chinese observations of comets and our European cometographies: to those who, on the contrary, are well acquainted with the history of comets, I think any observations on the authenticity of the data furnished by the Chinese annals will be quite unnecessary.

To return; the present enquiry is made on the supposition of an average period of 292 years, or the interval between 1264 and 1556. It will no doubt be asked—May not the interval include more than one revolution? If we suppose a period of 146 years, or half of the above, we shall find that the testimony of history does not entirely exclude such a modification, though no decisive evidence is to be obtained in favour of the hypothesis: thus we have recorded, a comet in the year 43 B. C., under the division *Tsan*, in the N.W., on May 17th; also in the years 245, 828, 1126, and 1408 of the Christian era we find mention of comets. In 1408 we have no particulars; but the imperfect accounts which have descended to us from B. C. 43, and A. D. 245, 828, and 1126, might be satisfied by elements not very widely different from those of the comet of 1556: on the other hand, comets recorded about the years 539 and 1702, offer no signs of identity with the one in question. History will not support any further diminution of the periodic time; and it is very unlikely that a comet of such magnitude, approaching near the earth's orbit in both its nodes, should have frequently passed by unobserved. After a careful examination of the matter, I think, in the

present state of our knowledge, we are rather justified in assuming a period of 291 years.

Deducting this period from 1264, we arrive at the year 973, about which epoch we may expect to find some mention of an appearance of our comet.

In 968, according to the authors of a History of the Church, published at Basle in 1564, a comet was seen. Modern cometographers, and particularly the astrological part of them, have not failed to record it, together with the events that followed. The evidence on which the appearance of this comet rests is by no means decisive.

"A sign of a fiery colour" was seen in the heavens in 971, as we learn from the Chronicle of Conrad, Abbé of Ursperg. But, asks Pingré, was this a comet? It is not easy to answer the question. I find no mention of it in other authors.

In the reign of John Zimisces, in the month of August, third indiction (therefore in 975), a "bearded comet" was observed. It remained visible until the eighth month, fourth indiction, or until the month of October, 975. Many European authors record the appearance of a comet during the autumn; amongst them are several English historians, whose writings are collected in the works "*Historiæ Anglicanæ Scriptores Decem, Londini,* 1652," and "*Rerum Anglicarum Scriptores Veteres, Oxoniæ,* 1684-7." In the eighth year, *Kai-pao,* on day *Kia-tse* of the sixth moon (August 3rd), a comet began to be perceived in China, in *Lieou.* It was seen in the morning in the eastern heavens, with a tail 40° long. The comet traversed *Yu-Kouei,* and arrived at *Toung-pi.* It was seen, in all, 83 days. Father Mailla says it was discovered before the 11th of July. *Lieou, Yu-Kouei,* and *Toung-pi* are sidereal divisions; *Lieou,* commencing at δ Hydræ, *Yu-Kouei* at θ Cancri, and *Toung-pi* at γ Pegasi. In Gaubil's manuscript the word *constellation* is prefixed to each

but the comet could hardly be visible in the group *Lieou* on August 3rd: it would not rise in China until about half-an-hour before the sun. We must rather allow it some degrees of north latitude, the right ascension being greater than that of δ Hydræ, but not exceeding it more than 15°, which is the extent of the division *Lieou*. Now, as Pingré has observed, there is great probability in favour of the identity of this comet with that of 1556. If we assume my elements for 1556, reducing perihelion and node to 975, we shall find that a fair agreement between the calculated and observed path may be obtained, by fixing the perihelion passage in the early part of August. Pingré says the perihelion would take place some days before the end of July: probably he may have employed elements differing sensibly from mine. The comet would not be far elongated from the sun on August 3rd, but its north latitude would be sufficiently great to render it easily visible in the morning. It would retrograde through Cancer, Gemini, and Taurus, and might finally disappear in Aries, after eighty-three days' visibility. I may remark, further, that the position of the orbit of this comet is favourable to the exhibition of a long tail, when the perihelion passage takes place in July or August. It is, therefore, very probable that the comet of the reign of John Zimisces was no other than that of 1264.

The inequality of intervals 975-1264, 1264-1556, need not occasion surprise. In an orbit of such vast dimensions it is impossible to say how far perturbation may have affected the period of revolution; for the comet traverses regions where planets of great mass may exist, that are at present unknown to us. But the difference between these intervals, which amounts to 2.7 years, is certainly not larger than we might reasonably look for, from known causes of disturbance.

Another revolution of 291 years, counted backwards from 975, brings us to 684, about which year several comets are

recorded in the annals of China, as well as by European historians.

In the ninth moon of the year 681, on day *Ping-chin* (October 17th), a comet was seen in China, in the middle of *Tien-che*, or near the head of Hercules. Its tail was 50° long, but gradually diminished. The comet moved towards Aquila. On day *Kouei-tcheou* (November 3rd), it disappeared. This is Gaubil's account. Ma-tuoan-lin says, it moved towards the east, and reached *Ho-Ku* (α, β, γ Aquilæ). I find, by calculation, that these particulars cannot be represented by the elements of the comet of 1556. The comet of 681 appears to have described an arc nearly parallel to the equator, whereas that of 1556, when visible in these parts of the heavens, would have a rapid motion in declination towards the South.

In the second year of the period *Yung-tchung*, 683, on day *Ping-ou* of the third moon (April 20th), a comet was seen in the north of *Ou-tche*. On day *Sin-ouei* of the fourth moon (May 15th), it disappeared. This is extracted from the catalogue of Ma-tuoan-lin. The Chinese constellation *Ou-tche* agrees very nearly with our Auriga; it contains α, β, θ, ι Aurigæ, β Tauri, &c. If we reduce the elements of the comet of 1556 to 683, and assume the time of perihelion passage, May 13th, the comet on April 21st would be seen in 61° right ascension, with 45° north declination, or very exactly in the north of *Ou-tche*. Its distance from the earth would be 0.48.; and therefore it might be conspicuous in the north-western heavens. On May 15th, the position of the comet would be R. A. 25°, declination 31° north, distance from the earth=0.73. Consequently, it would be visible in the mornings, and its disappearance about this time can only be accounted for by the increased distance from the earth, or by the prevalence of unfavourable weather in China. There is apparently one objection to our recognising in the comet of 683, a return of that of 1264. If the perihelion passage

occurred about May 13th, the comet would have been visible and rather conspicuous for some time before April 21st; yet the Chinese make no mention of this circumstance. I cannot, however, consider this objection as absolutely fatal to our supposition of identity: the Chinese descriptions at this remote epoch are very imperfect, and we have no European authorities to guide our judgment.

In 684, two comets were observed. One was seen in China, in the first year of the period *Wen-ming*, seventh moon, twelfth day *Sin-ouei* (September 6th), in the western heavens: the tail was 10° long. It was visible forty-nine days, and disappeared on day *Kia-tchin* of the eighth moon (October 9th). Again we have,—"In the first year of the period *Kouang-tse*, on day *Ting-tcheou*, ninth moon (October 11th), a comet, resembling a half-moon, was seen in the north." Most probably, this comet is the same which other annals state to have disappeared on the 9th. The circumstances here related are incompatible with the orbit of the comet of 1556.

Anastasius, in his Ecclesiastical History, Sigonius, and others, assure us that, under the Pontificate of Benedict II., between Christmas and Epiphany, there was seen at night, near the Pleiades, an obscure star, which resembled the moon viewed through a cloud. The Comet of 1556 could not be situated near the Pleiades between Christmas and Epiphany.

Lubienietski, Zahn, and other cometographers, record the appearance of a comet in 684, which continued visible three months. These authorities are far from decisive.

Reckoning back another period of 291 years, we might expect to find some mention of an appearance of the comet of 1556 about 392.

The chronicle of the Count Marcellin informs us that "during the consulate of Primasius and Promotus, second

indiction, a star rose in the north at the hour of cock-crowing. It resembled the morning-star in brilliancy; and ceased to be visible after about twenty-eight days." The year indicated by these words is 389, which agrees with that assigned by Philostorgius and Nicephoras. According to these authors, "A strange and extraordinary star appeared in the heavens in the middle of the night, near Venus, towards the circle which is called the zodiac. As the rays with which it was surrounded rendered it large and brilliant, it almost equalled in brightness the morning star: it was seen to approach a great number of stars." After some fanciful details about the appearance of the comet, Philostorgius tells us it offered a spectacle altogether new. Its motion also differed entirely from that of the stars: it commenced moving from the place where it first appeared, rising and setting with the morning star; afterwards it receded from it gradually, and advanced towards Ursa Major. It seemed to move to the left of the observer. By its own proper motion, which continued forty days, it reached Ursa Major, and finally disappeared about the middle of that constellation. Philostorgius says, the comet made its appearance before the departure of the Emperor Theodosius from Rome, on his return to Milan, which took place at the beginning of September, 389. Pingré therefore thinks the comet must have appeared in August. He finds, however, that Venus was not a morning star in August, being then near her inferior conjunction, and shews that Philostorgius and Nicephoras have most probably mistaken Jupiter for Venus. In August, 389, Jupiter rose in the north-east, in the middle of the night.

In the fifteenth year of the period *Thai-youen*, seventh moon, on day *Jin-chin* (390, August 22nd), a comet was seen in the "Northern River," (α, β Geminorum); it traversed *Thai-wei* (stars of Leo and Virgo, about β Leonis), *San-tai*

(ι, κ, λ, μ, &c., Ursæ Majoris), and *Wen-tchang* (θ, υ, ϕ, τ Ursæ), and entered *Pe-teou* (α, β, γ, δ, ϵ, ζ, η Ursæ). Its colour was white, and its length 100 degrees. On day *Wou-su* of the eighth moon (September 17th), it entered *Tse-wei* (circle of perpetual visibility), and afterwards disappeared.

It is almost impossible to read the Chinese description of the comet referred to the fifteenth year of the period *Thai-Youen*, without perceiving the close resemblance between its path and that of the comet which Philostorgius, Nicephoras, and Marcellin date one year earlier. The European date is so well confirmed by the accompanying events, that we can hardly dispute its accuracy; but the Chinese annals may have retarded the comet's appearance one year. The Count Marcellin, however, assures us that another comet was seen under the fourth consulate of Valentinian, and the first of Neotoricus, third indiction (390), like a great column in the heavens: it was visible for thirty days. We cannot, therefore, decide whether the comet of Philostorgius differs from that observed in China. Suffice it for our present purpose to remark that the circumstances recorded are irreconcilable with the elements of the Comet of 1556.

In the twentieth year of the reign of Vu-ti, Emperor of China, 392, a comet appeared. It is mentioned by Couplet, in his "*Monarchiæ Sinicæ Tabula Chronologica.*" We have no further particulars.

In the eighteenth year of the period *Thai-youen* (393), second moon (commencing about March 30th), an extraordinary star became visible in the division *Ouei* (determined by μ^{2} Scorpii): it disappeared in the ninth moon (commencing about October 22nd). Even if this strange star, which was observed so long, were really a comet, it could not have been that of 1556.

In the year 395, seventh moon (between July 26th and

August 24th), a great comet was seen in China at the star *Siu-niu.* It moved towards the star *Cou-sin,* in the constellation *Hiu.* This is extracted from the General History of China, by Father de Mailla, t. IV., p. 496. Mailla was no astronomer, and frequently confounded stars with constellations, and constellations with sidereal divisions. The star *Siu-niu* is no doubt the division *Siu-niu,* commencing at ϵ Sagittarii. *Hiu* is determined by β Aquarii; but, as far as I am aware, the star *Cou-sin* has not been identified. Pingré, in the second volume of his *Cometographiè,* p. 136, says the above circumstances will apply very well to the comet of 1556; but, if the position in Sagittarius belongs to the seventh moon, or to the month of August, I do not see how it is possible to admit the identity of the comets.

Passing over another revolution of about 290 years, we find recorded the appearance of an extraordinary star in the sixteenth year of the period *Young-youen,* 104, on day *Wou-ou* of the fourth moon (June 10th), in *Tse-wei* (the circle of perpetual visibility): it moved to the sidereal division *Mao* (determined by η Pleiadum). It disappeared in the fifth moon. This comet might have been that of 1556.

If we go back still further into antiquity, we shall find the accounts become too vague to afford any hope of recognizing other returns of our comet. We have seen that in the years 975, 683, and 104, comets are mentioned bearing more or less resemblance to that of 1556; and in 392 another is recorded in the Chinese annals.

CHAPTER VI.

Ephemerides for facilitating the Re-discovery of the Comet.

The following ephemerides, showing the position of the comet in the heavens, for different suppositions as to the time of perihelion passage are calculated from my *parabolic* elements, deduced from the observations of Fabricius in 1556, the longitude of the node and perihelion being corrected for the effect of precession of equinoxes between 1556 and 1848. I have employed the method of co-ordinates, which is most convenient in computations of this kind. Calling the true anomaly at any time v, and the radius-vector r, the expressions for the comet's heliocentric co-ordinates, reckoned from the equinox of 1848, will be—

$x = r.\,[\,9.\,99999\,]\,sin.\,(\ \ 8^\circ\,24',4 + v)$
$y = r.\,[\,9.\,99699\,]\,sin.\,(278^\circ\,22',3 + v)$
$z = r,\,[\,9.\,06995\,]\,sin.\,(100^\circ\,31',7 + v)$

The quantities within the square brackets being logarithms.

x is measured on a line passing through the equinoxial point of date; y on a line in a plane parallel to the equator and perpendicular to the axis of x; and z perpendicular to the plane of the equator towards the north.

The equatoreal co-ordinates of the sun will be found from the formulæ—

$$X = R.\ cos.\ \odot$$
$$Y = R.\ sin.\ \odot\ cos.\ \omega$$
$$Z = R.\ sin.\ \odot\ sin.\ \omega = Y.\ tan.\ \omega$$

Where R is the earth's radius-vector, $\odot$ the true longitude of the sun, and ω the obliquity of the ecliptic.

The values of X, Y, Z, are now given in the Nautical Almanac, for every mean noon at Greenwich.

The geocentric right ascension, declination, and the distance of the comet from the earth (Δ) will be found as follows: —

$$tan.\ R.A. = \frac{Y + y}{X + x} \qquad tan.\ \delta = \frac{Z + z}{X + x}\ cos.\ R.A. \qquad \Delta = \frac{Z+z}{sin.\delta}$$

The table subjoined contains the values of the comet's heliocentric co-ordinates, and log. radii vectores in my orbit for every tenth day, from 90 days before the perihelion passage to 90 days after it.

Time from Perihelion.	x.	y.	z.	Log. radii vectores.
DAYS.				
— 90	— 1.74301	+ 0.57500	— 0.06027	0.26397
— 80	— 1.62308	+ 0.43703	— 0.04449	0.22570
— 70	— 1.49307	+ 0.29634	— 0.02843	0.18255
— 60	— 1.35042	+ 0.15327	— 0.01215	0.13327
— 50	— 1.19171	+ 0.00843	+ 0.00427	0.07619
— 40	— 1.01198	— 0.13637	+ 0.02059	0.00917
— 30	— 0.80390	— 0.27695	+ 0.03629	9.92995
— 20	— 0.55700	— 0.40312	+ 0.05012	9.83847
— 10	— 0.26113	— 0.49073	+ 0.05917	9.74743
0	— 0.07377	— 0.49610	+ 0.05832	9.70323
+ 10	+ 0.39287	— 0.39514	+ 0.04497	9.74743
+ 20	+ 0.65065	— 0.22660	+ 0.02391	9.83847
+ 30	+ 0.85030	— 0.03517	+ 0.00040	9.92995
+ 40	+ 1.00860	+ 0.15896	— 0.02325	0.00917
+ 50	+ 1.13854	+ 0.34903	— 0.04629	0.07619
+ 60	+ 1.24836	+ 0.53310	— 0.06854	0.13327
+ 70	+ 1.34329	+ 0.71090	— 0.08998	0.18255
+ 80	+ 1.42682	+ 0.88282	— 0.11067	0.22570
+ 90	+ 1.50148	+ 1.04923	— 0.13067	0.26397

The ephemerides which follow are adapted to the period between 1848, March 0, and 1849, February 0; but for those dates under the different hypotheses, when the comet is situated at a considerable distance from the earth and sun,

and consequently when these rough ephemerides will be chiefly useful in "sweeping," it is evident that they will apply equally well for the same dates in another year. The computed places are merely intended to indicate approximately the quarter of the heavens which should be telescopically examined, with the view to the comet's re-discovery. It is almost needless to observe, that the earlier this discovery is made, the better chance we shall have of determining the elements of the orbit with accuracy.

Perihelion Passage, March 0.

Date.	Right Ascension.	Declination.	Distance from Earth.
December.. 1	12h. 29m.	11°,4 S.	2.16
11	12 56	12 ,9	1.92
21	13 28	14 ,5	1.68
31	14 7	15 ,9	1.46
January .. 10	14 57	16 ,8	1.26
20	16 1	16 ,8	1.11
30	17 20	15 ,1	1.02
February .. 9	18 46	11 ,4	1.03
19	20 9	7 ,0	1.13
29	21 25	3 ,4	1.29
March 10	22 32	0 ,9 S.	1.48
20	23 29	0 ,8 N.	1.66
30	0 15	2 ,2	1.84
April 9	0 54	3 ,2	2.01
19	1 27	4 ,0	2.17
29	1 55	4 ,6	2.32
May..... 9	2 20	5 ,0	2.46
19	2 42	5 ,2	2.59
29	3 2	5 ,2 N.	2.69

Perihelion Passage, April 0.

Date.	Right Ascension.	Declination.	Distance from Earth.
January .. 1	12h. 45m.	15°,6 S.	1.66
11	13 11	17 ,0	1.40
21	13 43	18 ,4	1.16
31	14 28	19 ,3	0.94
February .. 10	15 32	19 ,1	0.75
20	17 3	16 ,0	0.62
March 1	18 53	8 ,9	0.59
11	20 32	0 ,9 S.	0.69
21	21 49	4 ,3 N.	0.88
31	22 52	6 ,9	1.11
April 10	23 48	8 ,0	1.34
20	0 36	8 ,4	1.55
30	1 17	8 ,6	1.74
May..... 10	1 50	8 ,6	1.90
20	2 19	8 ,5	2.04
30	2 44	8 ,2	2.16
June..... 9	3 6	7 ,8	2.26
19	3 25	7 ,2	2.35
29	3 41	6 ,4 N.	2.41

Perihelion Passage, May 0.

Date.	Right Ascension.	Declination.	Distance from Earth.
January .. 31	12h. 23m.	17°,9 S.	1.16
February .. 10	12 35	18 ,6	0.91
20	12 51	18 ,8	0.68
March 1	13 16	17 ,8	0.46
11	14 10	12 ,9 S.	0.26
21	17 31	12 ,9 N.	0.12
31	21 59	28 ,5	0.23
April 10	23 14	26 ,2	0.43
20	23 52	23 ,4	0.66
30	0 27	20 ,5	0.91
May..... 10	1 7	17 ,9	1.15
20	1 45	16 ,0	1.35
30	2 18	14 ,4	1.52
June..... 9	2 47	13 ,0	1.66
19	3 10	11 ,7	1.77
29	3 31	10 ,3	1.86
July..... 9	3 48	8 ,8	1.93
19	4 2	7 ,3	1.98
29	4 14	5 ,5 N.	2.02

Perihelion Passage, June 0.

Date.	Right Ascension.	Declination.	Distance from Earth.
March 2	10h. 39m.	12°,2 S.	0.87
12	10 16	7 ,9	0.72
22	9 46	1 ,4 S.	0.60
April .. . 1	9 9	7 ,9 N.	0.51
11	8 27	19 ,3	0.46
21	7 36	31 ,3	0.44
May..... 1	6 31	41 ,9	0.45
11	5 3	48 ,0	0.49
21	3 33	45 ,9	0.57
31	2 48	37 ,8	0.72
June..... 10	2 49	29 ,7	0.89
20	3 7	23 ,8	1.06
30	3 28	19 ,6	1.20
July..... 10	3 46	16 ,1	1.30
20	4 2	13 ,0	1.38
30	4 14	10 ,1	1.44
August.... 9	4 23	7 ,2	1.49
19	4 29	4 ,2	1.52
29	4 32	1 ,2 N.	1.54

Perihelion Passage, July 0.

Date.	Right Ascension.	Declination.	Distance from Earth.
April 2	8h. 58m.	1°,5 N.	1.10
12	8 45	5 ,9	1.06
22	8 37	10 ,4	1.04
May..... 1	8 31	14 ,7	0.99
11	8 29	19 ,1	0.97
21	8 29	23 ,7	0.93
31	8 30	28 ,9	0.86
June..... 10	8 24	35 ,2	0.78
20	7 57	42 ,5	0.69
30	6 43	46 ,6	0.63
July 10	5 26	40 ,9	0.66
20	4 54	31 ,5	0.73
30	4 46	23 ,4	0.81
August.... 9	4 45	16 ,8	0.88
19	4 44	10 ,9	0.93
29	4 41	5 ,6	0.97
September 8	4 34	0 ,4 N.	1.01
18	4 24	4 ,4 S.	1.05
28	4 9	8 ,8 S.	1.10

Perihelion Passage, August 0.

Date.	Right Ascension.	Declination.	Distance from Earth.
May..... 2	8h. 39m.	7°,7 N.	1.57
12	8 42	10 ,1	1.56
22	8 49	12 ,2	1.54
June..... 1	8 59	14 ,3	1.50
11	9 12	16 ,3	1.44
21	9 28	18 ,2	1.36
July..... 1	9 46	20 ,5	1.25
11	10 7	23 ,1	1.10
21	10 26	26 ,8	0.92
31	10 29	31 ,9	0.71
August.... 10	9 50	36 ,6	0.53
20	8 27	35 ,3	0.42
30	6 55	25 ,1	0.37
September 9	5 42	10 ,3 N.	0.38
19	4 45	3 ,1 S.	0.43
29	3 58	12 ,8	0.51
October .. 9	3 19	18 ,7	0.63
19	2 48	21 ,7	0.77
29	2 24	22 ,8 S.	0.94

Perihelion Passage, September 0.

Date.	Right Ascension.	Declination.	Distance from Earth.
June..... 2	8h. 58m.	9°,0 N.	2.07
12	9 9	10 ,1	2.03
22	9 24	10 ,9	1.99
July..... 2	9 41	11 ,6	1.91
12	10 1	12 ,2	1.82
22	10 24	12 ,6	1.70
August.... 1	10 52	13 ,0	1.55
11	11 24	13 ,3	1.37
21	12 1	13 ,5	1.15
31	12 40	13 ,4	0.90
September 10	13 15	11 ,7	0.64
20	13 53	5 ,8 N.	0.40
30	15 10	13 ,7 S.	0.21
October .. 10	19 45	48 ,2	0.19
20	22 59	40 ,9	0.35
30	23 51	33 ,8	0.55
November 9	0 15	29 ,4	0.77
19	0 31	26 ,1	1.00
29	0 43	23 ,3 S.	1.25

Perihelion Passage, October 0.

Date.	Right Ascension.	Declination.	Distance from Earth.
July..... 2	9h. 29m.	7°,9 N.	2.47
12	9 46	8 ,1	2.39
22	10 4	8 ,1	2.31
August.... 1	10 25	7 ,9	2.20
11	10 50	7 ,5	2.07
21	11 18	6 ,9	1.92
31	11 51	6 ,1	1.75
September 10	12 31	4 ,9	1.56
20	13 19	3 ,2	1.34
30	14 15	0 ,3 N.	1.11
October .. 10	15 20	4 ,8 S.	0.88
20	16 40	12 ,9	0.70
30	18 23	21 ,9	0.64
November 9	20 14	27 ,2	0.68
19	21 43	27 ,2	0.82
29	22 43	25 ,1	1.02
December.. 9	23 46	22 ,4	1.24
19	23 57	19 ,9	1.48
29	0 20	17 ,5 S.	1.72

Perihelion Passage, November 0.

Date.	Right Ascension.	Declination.	Distance from Earth.
August.... 2	10h. 7m.	5°,2 N.	2.74
12	10 27	4 ,7	2.62
22	10 48	4 ,1	2.49
September 1	11 12	3 ,2	2.34
11	11 40	2 ,2	2.19
21	12 13	0 ,9 N.	2.02
October .. 1	12 52	0 ,7 S.	1.85
11	13 39	2 ,6	1.66
21	14 36	5 ,0	1.47
31	15 45	8 ,3	1.29
November 10	17 4	12 ,7	1.13
20	18 30	17 ,2	1.05
30	19 57	20 ,0	1.07
December.. 10	21 13	20 ,5	1.14
20	22 15	19 ,3	1.32
30	23 18	17 ,7	1.50
January .. 9	23 41	15 ,4	1.73
19	0 12	13 ,3	1.96
29	0 38	11 ,4 S.	2.20

Perihelion Passage, December 0.

Date.	Right Ascension.	Declination.	Distance from Earth.
September 1	10h. 46m.	1°,7 N.	2.83
11	11 7	0 ,7 N.	2.68
21	11 31	0 ,4 S.	2.52
October .. 1	11 58	1 ,7	2.34
11	12 30	3 ,2	2.16
21	13 7	4 ,8	1.98
31	13 52	6 ,6	1.81
November 10	14 47	8 ,5	1.65
20	15 53	10 ,5	1.51
30	17 11	12 ,7	1.40
December.. 10	18 35	14 ,7	1.34
20	19 57	15 ,9	1.34
30	21 9	15 ,8	1.42
January .. 9	22 10	14 ,7	1.55
19	23 0	13 ,0	1.72
29	23 40	11 ,1	1.92
February .. 8	0 14	9 ,3	2.13
18	0 42	7 ,6	2.34
28	1 7	6 ,0 S.	2.56

Perihelion Passage, January 0.

Date.	Right Ascension.	Declination.	Distance from Earth.
October .. 2	11h. 25m.	2°,6 S.	2.77
12	11 48	3 ,9	2.57
22	12 14	5 ,4	2.38
November 1	12 45	6 ,9	2.18
11	13 21	8 ,5	1.98
21	14 5	10 ,2	1.80
December.. 1	14 57	11 ,6	1.64
11	16 2	12 ,7	1.52
21	17 17	13 ,2	1.46
31	18 40	13 ,1	1.44
January .. 10	20 2	12 ,6	1.48
20	21 15	11 ,5	1.57
30	22 17	10 ,2	1.68
February .. 9	23 7	8 ,5	1.84
19	23 49	6 ,8	2.02
March 1	0 25	5 ,2	2.21
11	0 55	3 ,7	2.40
21	1 21	2 ,3	2.59
31	1 45	1 ,2 S.	2.77

Perihelion Passage, February 0.

Date.	Right Ascension.	Declination.	Distance from Earth.
November 2	12h. 1m.	7°,2 S.	2.52
12	12 26	8 ,7	2.30
22	12 56	10 ,3	2.07
December.. 2	13 30	11 ,9	1.86
12	14 13	13 ,3	1.66
22	15 5	14 ,4	1.49
January .. 1	16 8	14 ,8	1.36
11	17 23	14 ,0	1.30
21	18 45	12 ,1	1.32
31	20 7	9 ,7	1.40
February .. 10	21 23	7 ,5	1.52
20	22 27	5 ,6	1.67
March 2	23 20	3 ,9	1.83
12	0 3	2 ,3	1.99
22	0 40	0 ,9 S.	2.17
April 1	1 11	0 ,3 N.	2.34
11	1 39	1 ,3	2.57
21	2 3	2 ,1	2.66
May..... 1	2 25	2 ,7 N.	2.81

REMARKS

ON THE PRECEDING EPHEMERIDES.

Perihelion Passage, March 0.

On this supposition the comet would only be observable before the perihelion passage during the mornings of December and January, and even then its distance from the earth would prevent its being at all conspicuous. On December 1st it would rise at a quarter before three in the morning and on January 11th about twenty minutes later.

Perihelion Passage, April 0.

The comet might be easily observed up to the time of perihelion, and a few days longer. After that it would rise too nearly at the same time as the sun to be visible. The nearest proximity to our globe occurs at the end of February, the comet being then situated between the constellations Ophiuchus and Aquila. It might be detected before the commencement of the year on the confines of Virgo and Corvus.

Perihelion Passage, May 0.

On this hypothesis the comet would be well seen before the perihelion, and might be discovered at the beginning of the year. About March 21st its nearest approach to the earth

would take place, the comet moving pretty rapidly at that time from Hercules through Vulpecula to Pegasus. After the first ten days of May its distance from the earth and presence in the strong morning twilight would interfere with observations. Perhaps towards the latter end of July the comet might be again detected with powerful telescopes: it would be very faint owing to its great distance from the earth and sun.

Perihelion Passage, June 0.

In this case also the comet might be very conspicuous before the perihelion passage, its course lying through Sextans, Hydra, Cancer, close to the stars Castor and Pollux (in which position it would be nearest to the earth), through Auriga and Perseus to Aries. Observations might be carried on in June, but not later, the comet being too near the sun's place.

Perihelion Passage, July 0.

On this supposition it would be very conspicuous towards the end of June, or at any rate would be nearest to the earth at that time. From the middle of June until about July 12th it would be constantly above the horizon of London. During the whole period included in the ephemeris, as far as depends on the comet's position in the heavens, it could be very well observed. The intensity of light on April 2nd and September 28th = 0.25, and on the day of perihelion, June 30th, = 9.87. The commencement of July is about the most favourable time that the perihelion can possibly occur: during this month and part of August the comet would no doubt be a fine object in our summer sky, if it has not very much diminished in brilliancy since 1264, when its splendid nucleus and enormous tail astonished and terrified our forefathers.

Perihelion Passage, August 0.

Observations could be made in the evenings up to the day of perihelion passage, and soon after that epoch in the mornings. The comet would cease to be visible in the evening, towards the latter end of August; but rising then, four hours or more, before the sun, and being near the earth, might be very conspicuous in the morning sky, and remain so during September. At the beginning of November it would be in opposition, but its distance from the earth being greater than 1.0, and that from the sun nearly 2.0, it could not be seen probably without good telescopes. The closest approach to our globe occurs at the beginning of September, at which time we should be distant from the comet something less than thirty-five millions of miles.

Perihelion Passage, September 0.

On the first date in the ephemeris, June 2nd, the sun sets in London at five minutes before eight, and the comet at five minutes after eleven; the intensity of light = 0.08. It would not be an easy matter to discover the comet at this time. During the month of July it would probably be too near the sun to be visible. On the 15th of August it sets two hours after the sun, and might be discovered about this time, perhaps earlier. During the evenings of September it could be well observed, and should become conspicuous as it approaches near the earth, towards the end of the month. After the beginning of October the comet would be lost in these latitudes, owing to its great south declination. In the southern hemisphere it might be an imposing object in the heavens; sweeping rapidly through Scorpio, Norma, Telescopium and Grus. At the beginning of November it would again be visible in London, below the tail of Cetus in Apparatus Sculptoris. About the first week in October the intensity

of light = 26.7, the comet approaching within eighteen million of miles distance from our globe.

Perihelion Passage, October 0.

Before the perihelion the comet always sets too soon after the sun, and is too far from the earth, to allow of its being easily detected, at least until the end of September. On the day of perihelion passage it sets two hours after the sun, distant from us 1.1. During October and November we might observe it in these latitudes, though it can hardly be expected to be very conspicuous at any time, on the present hypothesis. Its apparent path would lie through Libra, Ophiuchus, Sagittarius, and Capricornus.

Perihelion Passage, November 0.

On this supposition the comet would be too near the sun's apparent place to be visible before the beginning of November. It would never approach nearer to us than the mean distance of the earth from the sun. Observations might be continued from the beginning of November until the end of January following, or later.

Perihelion Passage, December 0.

This is a very unfavourable epoch for the perihelion to occur, the distance from the earth being always very considerable. Observations could be made after the middle of December. In the interval, from December 10th to the end of February following, it would pass between Sagittarius and Aquila, near β Capricorni, through Aquarius and Pisces into Cetus.

Perihelion Passage, January 0.

The conjunction with the sun in Right Ascension takes place on or about the day of perihelion. The comet could not be discovered for some weeks after that time. It would be most

favourably situated for observations in February, but even then at a great distance from the earth.

Perihelion Passage, February 0.

On November 2nd, the first date in the ephemeris, the comet rises three hours and a quarter before the sun, and on December 12th more than four hours before him, situated during the interval in the constellation Virgo. Though visible with the aid of telescopes, its distance from the earth would probably render observations somewhat difficult. On the 11th of February the comet is in conjunction with the sun in Right Ascension. It might be seen until the latter end of January, and would be most favourably placed for observations during the first ten days of that month. There would be no chance of seeing it after the perihelion passage.

CHAPTER VIII.

General Remarks.

The results of the calculations into which I have been led, relative to the comets of 1264 and 1556, induce me to place some confidence in the correctness of the supposition as to their identity. We have seen that, on certain hypotheses, with respect to the time of perihelion passage, the comet might visit these parts of space, without a chance of its becoming visible, or at any rate conspicuous to the naked eye; and this circumstance is sufficient to account for our not being able to trace the history of the comet satisfactorily before the year 975.

If we assume the period of revolution about $291\frac{3}{4}$ years, we have the following numbers, shewing the dimensions of the ecliptical orbit.

Major Axis	87.98	(The Earth's mean distance=1.)
Minor Axis	13.29	
Aphelion distance....	87.48	
Perihelion distance ..	0.505	

The comet in its aphelion is therefore situated at a distance of eight thousand three hundred millions of miles from the sun—a space which light would require more than twelve hours to traverse, though moving at the rate of one hundred and ninety thousand miles in a second of time. In perihelion, the comet's distance from the sun is less than forty-eight millions of miles. The minor axis of the orbit is one thousand two hundred and sixty millions of miles broad.

The heliocentric latitude in aphelion is $29° 49'$ south.

The ascending node is passed about fifty days before the perihelion, the radius-vector being 1.182; and, consequently, the comet's distance outside the earth's orbit, 0.185. The passage through descending node occurs thirty-one days and a half after perihelion, the radius-vector being 0.872, and therefore the distance from our orbit, inside, 0.132. Hence it is easy to see that the comet approaches very near the earth at the ascending node, when the perihelion takes place, about May 8th, and at the descending node when it falls about August 21st.

The earth is the only planet which is likely to produce any very great perturbations in the elements of the comet's orbit. Professor Mädler has investigated how far the semi-axis-major would be altered by the near approach of the comet to our globe in 1556; but it appears that, in this case, the earth had no serious effect, the time of revolution being increased fourteen days and a half only. The united effects of the great planets in the system, and other causes, may tend to retard the next return of the comet to perihelion many months, possibly several years; for, although the trajectory does not encounter the orbits of the larger planets, these bodies must still exercise very sensible influence on the movements of the comet at a considerable distance from the sun. The actual calculation of the perturbations during a period of six hundred years is out of the question, especially upon such data as we now possess; we must, therefore, be content to watch closely for the re-appearance about the positions indicated by the elements of 1556. It will be a matter of high importance in this department of astronomy, should the comet return agreeably to our expectations: and I venture to hope that observers will keep a close look-out at every favourable opportunity, and not be entirely discouraged if the half-century should be completed, before this celebrated body discloses itself to our view.

It was remarked in 1845, that the elements of the comet discovered in the Southern Hemisphere in December 1844 bore some slight resemblance to those of the comet of 1556; but the differences are far too great to permit the supposition of identity. The ascending nodes differ 60°, the perihelia nearly 20°, the inclinations 15°, and the least distances 0.25. The perturbations of known planets are totally inadequate to produce variations of this enormous magnitude; and, as we may infer from analogy, that any unknown planets of great mass will lie near the plane of the ecliptic, there seems no way of accounting for such vast perturbations, since the comet of 1556, near its aphelion, is always far removed from that plane.

APPENDIX.

The following are somewhat free Translations of the passages from Thierri, Giles, and Gemma, given in Latin at pages 12, 14, and 35.

Page 12. *From Thierri's Poem on the Life of Pope Urban IV.*

After these things mention must be made of the prodigy of a hairy star, which is to apprize us of the death of so great a man. For its first apparition boded his illness, and its disappearance his death, as events have proved. In the year 1264, on the 6th day before the calends of August, on Sunday, in the morning, it was first perceived by us. The sun being in the eleventh degree and more of Leo, the comet was situated in 30° of Cancer. Besides its retrograde motion towards the west, it had another towards the south. So, moving in these directions it traversed Orion, and was seen in this country seventy days. On the 16th day before the calends of August it was observed in France. Not only Tuscany and France beheld it, but likewise the inhabitants of Acon. * * When the Pope Urban IV. was dying, the comet disappeared, as though it had been aware of his death.

Page 14. *From Tractatus Fratris Ægidii de Cometis.*

A tailed or hairy star appeared in the kingdom of France in the east before sunrise, from the 19th of the calends of August until the 5th of the nones of October in A. D. 1264.

We first saw the comet, on account of which we write, without the Zodiacal circle, towards the north under Cancer,

and, lastly, we saw the same without the circle, towards the south, under Gemini, between Canis (Minor) and Orion.

Moreover, we also beheld the tailed star, on account of which we write this, besides the diurnal circular motion, to be moved as well with a retrograde motion, like no other, as respects its latitude, which is from north to south. It was observed to move, during two solar months, more than 40°, scarcely changing its longitude 3°.

The comet, on account of which we write these things, was first seen in the evening after sunset, subsequently, after a few days, passing the sun in the morning, about the 8th degree of Cancer, and hence it quickly retrograded into Gemini. Besides, we saw the comet move from north to south more than 50° in latitude, scarcely changing its longitude 5°.

Page 35. *From Cornelius Gemma, as given by Hevelius.*

In the first place there appeared that fearful omen—the comet,—which shewed itself about two years after the earthquake, in the year of Grace 1556, from the beginning of March (as many affirm), until the 23rd of April. Paul Fabricius observed the course of this star very diligently, but only from March 4th until March 13th. At that time, indeed, I applied myself less negligently to mathematics, but did not well attend to the observations on each day. Nevertheless, this comet was remarked by me on March 3rd, to be situated not far from the ecliptic, under the sign Libra, the tail being very long, stretched out towards the west, and in the direction of a right line drawn from the sun through the head of the comet, on the opposite side. Shortly before the proximity of the sun removed it from our sight, having passed almost through the pole of the ecliptic, it was observed to reach the Chair of Cassiopea about the 18th of April. When I last examined its position with instruments, I found it not far from the pole of the ecliptic, but nevertheless in the sign Leo, if its place be referred to the zodiac. Those who watched more closely saw it disappearing not far from the

position which the new star now occupies; and I deem this the more likely, seeing that, in another book, it is stated by me that the comet was perceived until the 23rd of April. I believe the head of the comet would have traversed the zodiac before it left us. Indeed, it commenced moving at the beginning of March, from the sign Libra upwards, towards the pole, but obliquely, and subsequently in longitude towards the beginning of Libra; it advanced sometimes 8° and 9° in latitude, at one time a little slower, at another more rapidly. On the third day (March), it was only 6° distant from Spica, exactly in the right line joining Spica and the lower star under the girdle of Virgo, the tail being directed towards the left wing. Hence, mounting almost in a straight line until it came to the tropic, or declination 23°, about the eighth day. Then retrograding some degrees, it quickly reached the end of Leo, passing over another right line as respects the latitude; it was seen until the twenty-third day, running directly towards the pole of the ecliptic (from which it was not far distant), and rapidly passing through the whole signs, Leo, Cancer, and Gemini, until it arrived in the other quadrant of the circle under the sign Taurus, not far from Cassiopea. However, at that time it was not seen by us, but was hid from our sight on account of the proximity of the sun, (since it could only be observed at the third hour in the morning). It moved far the more quickly when near the poles, nor was it seen much diminished in magnitude, even at the end of its appearance. The tail always at first turned towards Spain, was afterwards directed more and more to the west, and lastly, in the month of April, exactly towards the pole of the zodiac, the sun being then placed with the planet Mars in a right line joining the head of the comet and this pole.

To the Editor of the Times

Sir. In my letter addressed to you on the 7th of March which appeared in The Times of the following day I mentioned the possibility of a considerable delay in the return of the comet of 1264 & 1556 owing to the attraction of the larger planets particularly Jupiter & Saturn. I have just received from M Bonnie of Middlebrough a very complete memoir on this subject which has been recently published by the Royal Academy of Sciences in the Netherlands. It is the result of a long series of calculations performed on the most approved methods of modern mathematicians. The conclusions being of general interest I may very briefly state them here as the paper itself is not very likely to fall

under the notice of non English readers

In order to predict the time of the reappearance of a comet mov= =ing in an elliptic orbit with allowance for the attractions of the planets it is necessary that we should know the precise time of revolution corresponding to some past epoch (as for instance the previous perihelion passage) or the period which the comet would require to perform its circuit round the sun if all plane= =tary disturbances were to cease from that moment. The comet in question was observed in 1264 & 1556 & the interval be= =tween the perihelion passages in those years amounted to 106,667 days or 291 3/4 years; but this tells us nothing with respect to the length of period corresponding

=ding to the ellipse described at the instant of perihelion either ~~at~~ in 1264 or 1556 since it includes the united effects of planetary perturbations between those years. Therefore before we can ascertain the epoch of the next return, we must calculate the amount of acceleration or retardation due to the disturbances be=tween 1264 & 1556 which being applied to the above period gives us the exact time of re=volution of the comet at the moment of the perihelion pas=sage in the former year & hence we ~~obtain~~ ascertain the period in 1556. Having found this we can calculate how much it would be increased or diminished by planetary attraction up to the present

time and thus determine the date of the next arrival at Perihelion. This is essentially the method adopted by M Bouvard & he hereby performed a great part of the computations in duplicate first with elements of Halley in 1556 found in all our catalogues of cometary orbits & again with the final elements published in the Astronomische Nachrichten of Prof. Schumacher, the Comptes Rendus of the French Institute, the Notices of the Royal Astronomical Society, & elsewhere; this last set only came to M Bouvards knowledge when he had nearly completed the first series of calculations, but as he considered them more exact he went through the greater

part of the south again. With these elements taking into account the attraction of Jupiter Saturn Uranus & Neptune between 1264 & the present time & of Venus & the Earth in 1556 it is found that the length of the comets revolution at the time of perihelion passage in 1264 was was 110,644 or 302.922 years and in 1556, 112,561 or 308.169 years; that the effects of Saturn = ation will diminish this pe = riod 2,166 days & therefore the present revolution will occupy 110,395 days or 302¼ years so that the comet will return again to its perihelion on the 2d of April 1858 & will then be moving in an ellipse of 112,785 days' period. With Halleys elements the true time

of revolution of the comet in
1556 was 112,943 days & the
perturbations should diminish
the ensuing period about 1,797
days hence we find the next
perihelion passage will occur in
August 22, 1860
Thos M Bourne concludes that
if the true elements of the orbit
in 1556 were within the limits
assigned by Halleys calculations
& my own the comet will appear
again ~~in~~ between 1858 & 1860.
The main cause of this uncer-
=tainty is the difference between
the two determinations of the
position of the major axis or line
of Apsides in 1556. Halley fixes
the perihelion ~~in~~ in longitude
278° 56' while I place it in
longitude 274° 15' deviating
4° 35'. Having expended a
good deal of time & trouble

some years ago on the calculations for my orbit I believe that I may safely state that the utmost allowance that can be made for error in the position of the major axis does not exceed 4° so that it is probable that the time fixed for the return of the comet by my elements (August 2, 1858.) must be within two years of the truth & therefore we have but little chance of seeing it within six years of this time. At any rate the supposed delay in its reappearance is fully accounted for through the zeal & industry of M Bouvard whose calculations as regards extent & intricacy may vie with those of Clairault & Rosenberg for Halleys comet

* * * *

(a paragraph follows about some results obtained by Mr Barber BA 1849 of Trin. Coll. Cambridge which were ~~the~~ obtained on incorrect data ~~as~~ & so made the perturbations much too small)

* * * *

I think that there are not many individuals who have had courage to attack the doubtful & laborious problem which M Bonne has so satisfactorily solved & it is only right that he should receive his due share of praise if the the comet should return at the time he has predicted

I remain Sir your most obedient Servant

J R Hind

April 2 (1850)

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